Surveyor 1

GREEN ENERGY Compass

To find an approved contractor for your home improvements, visit: http://ecasavesenergy.org/contractor. We recommend getting at least three bids. If you would like assistance reviewing proposals, please contact Elyse Green at elyseg@ecasavesenergy.org or by phone at 215-609-1052.

For information on financing, visit AFC First Financials Keystone HELP website at: http://keystonehelp.com/info/Energyworks.php.

To schedule a test out verification, email: EnergyWorksTestOut@ecasavesenergy.org with a copy of the completed work scope.

To find out more information on navigating the EnergyWorks program, visit: http://ecasavesenergy.org/services/energy-works/energyworks

ABOUT THIS REPORT

- Your in-home evaluation was conducted on 3/14/2013. During the inspection, I evaluated your home's structural elements, heating/cooling equipment, and energy consuming appliances.
- The information gathered during the home inspection provided input data to benchmark the energy use of your home and develop a strategic plan for the most effective way to reduce that energy usage.
- The attached report details the proposed improvement measures including expected savings for your home. If you have any questions about your home's energy performance, please contact me.
- Implementing these recommendations will reduce your energy bills and make your home more comfortable and more valuable.
- It's important to note that savings estimates provided are approximations to help you prioritize changes. The estimations should not be taken as firm commitments.
- Actual energy savings are impacted by many things such as climate, selected improvements, use habits, utility costs. Your true savings will be based on comparison of utility data prior to the improvements with data a year after the improvements are made.
- **This report and attached Field Sketch are designed to both educate you about loss issues in your home and serve as the Scope of Work for the recommended improvements in order to assist you with Contractors.**
- There are no cost estimates for the recommended improvements included in this report.
- It is recommended that you contact a minimum of three (3) pre-qualified Contractors who specialize in Home Performance improvements that are available through the above database, obtain firm pricing and take advantage of the financing options and Quality Assurance standards available through the program.
- SSEU can help you take the next step and will review proposals on your behalf after you obtain them to verify that your needs are being addressed. I will follow up with you regarding this matter in the future.

HOME ENERGY AUDIT REPORT

Audit Date: 3/14/2013

BUILDING INFORMATION

Date of Visit	March 14, 2013	Year Built	1960
Conditioned Area	2558	Number Occupants	4
Foundation Type	Slab-On-Grade	Number Bedrooms	3
Attic Type	Vented Attic	Number Stories	2

HOME OWNER INTERVIEW

During the pre-inspection interview you communicated that your main objectives are as follows:
Identify the sources of energy loss so they can be corrected in order to reduce utility costs and improve the comfort of the home. Areas of specific concern were noted as follows:

1. **The Laundry room is always cold.**
    - The space is not conditioned.
    - The door to the exterior is a poorly insulated wood panel type with poor weather-stripping and no storm door.
    - Leakage was observed at all penetrations through the ceilings, and around the perimeter joint where the ceiling meets the walls during the BD test.
        - This indicates that the floor joists concealed above the ceiling is not sealed.
    - Refer to the Miscellaneous Air sealing and Exterior Door Improvement sections.
2. **Want to verify that the minimum level of natural ventilation has not been encroached after a previous air sealing effort at the Attic in order to maintain indoor air quality.**
    - The house is tighter than most typical homes because of the air sealing effort in the Attic. However, there is still room for additional improvement when using current BPI protocol ASRAE 62.89.
        - A larger air sealing delta exists when using the ASHRAE 62.2 standard.
    - No significant evidence of moisture infiltration or mold was observed.
        - Some mold on the drywall under the Laundry sink can easily be remediated.
        - The simple air sealing measures recommended at the Garage and the wall that separates the garage will further prevent any unhealthy air quality issues associated with the Garage (fumes, etc) from infiltrating the home.
    - Refer to the Air sealing section for more information.
3. **Want a different opinion on any remaining air sealing opportunities that may be available.**
    - There are some remaining opportunities in the Attic and other areas that can be addressed.
    - Refer to the Air sealing section for more information.
4. **Want to verify if there is the proper level of insulation in the Attic.**
    - The overall thermal resistance value of the insulation in the Attic (R20) is less than the required minimum for this region (R38 – R40).
    - Refer to the Attic Insulation section for more information.

GENERAL SUMMARY

- The house is a split level type with normal exposure. This type of construction is typically found to have higher leakage rates.
    - The wall cavity that connects the 2 sides of the house is often source of exfiltration of conditioned air out through the top in the attic via the stack effect.
        - Cold air infiltration from the lower levels that are located at each side replaces the warm conditioned air and pushes it out through the unsealed vertical wall at the change in levels at the Attic space and other points of exit via poorly sealed top plates and penetrations.
            - This conditioned is reversed during the summer.
- The inspection, Thermal Images, and the Blower Door test indicate the potential for reasonable energy savings and improved comfort by a thorough “targeted” air sealing effort and insulation upgrades with emphasis on the Attic, windows, and other areas indicated in the report.
    - Refer to the appropriate Improvement sections for more information.

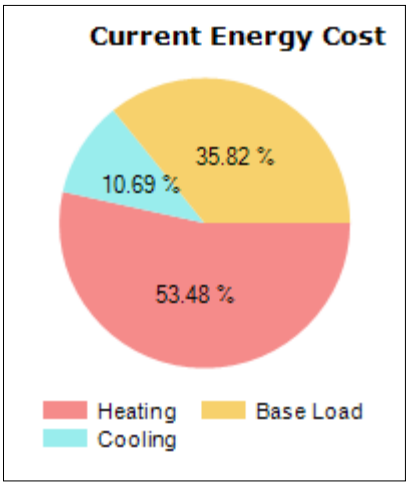
  - Refer to Field Sketches FS1 & FS2 provided along with this report.
- Based on the lower leakage rate and inspection overall the house is well sealed and insulated with the exceptions noted in the report.
- **The main objective of the recommendations is to address specific areas where leakage was observed, and improve on the existing air sealing measures in the Attic in order to correct the drafts, and energy loss associated with the concentrated exfiltration out the top and cold air infiltration at the bottom at the few remaining areas that need improvement.**
  - *Refer to comments regarding the Blower Door Test part of the Air sealing section, and the Measurements section regarding the use of the ASHRAE 62.2 standard to develop the minimum Building Air flow Standard (BAS), as well as information regarding the current BPI standard ASHRAE 62.89.*
- The inspection, Thermal Images, and the Blower Door test indicate the potential for significant improved comfort and some energy savings and by a "**targeted air sealing effort"** and insulation upgrade with emphasis on the Attic, and the exposed perimeter band joist, Garage wall, and other areas indicated in the report.
  - **Blower Door guided air sealing is strongly recommended**.
  - Refer to the appropriate Improvement sections for more information.
- The attic floor is under insulated for this region.
- There is no Basement, the lower (first) level and Garage levels are concrete SOG.
- With the exception of the first level where there are un-insulated masonry walls, exterior walls are reasonably insulated.
- Most doors to the exterior or the unconditioned garage require some type of improvement to the perimeter seals, and/or replacement.
  - Especially the 2 large glass doors located at the front elevation that is subject to northerly winds.
- Most windows throughout are older, single glazed, wooden types with older aluminum storm windows.
  - Addressing the leakage at windows is given a higher priority here than normal based on observations during the BD test, and the fact that the perimeter band joist is not reasonably accessible without the need for significant restoration of finished ceilings.
- The 2012 Goodman air source heat pump for heating (8.25 HSPF) and cooling (14 SEER) equipment are new, and highly efficient. A programmable "nest" thermostat is used.
- The 2012 AO Smith heat pump domestic hot water heater is extremely efficient.
- Most Appliances are newer.
- Some CFL's were observed during the inspection.
  - Refer to the comments, and Buyers Guide in the following section for information.
  - **Replace the most frequently used lights immediately to start saving energy and money**.

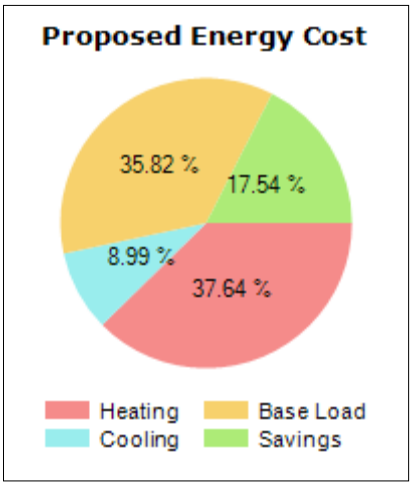
HOME ENERGY AUDIT REPORT

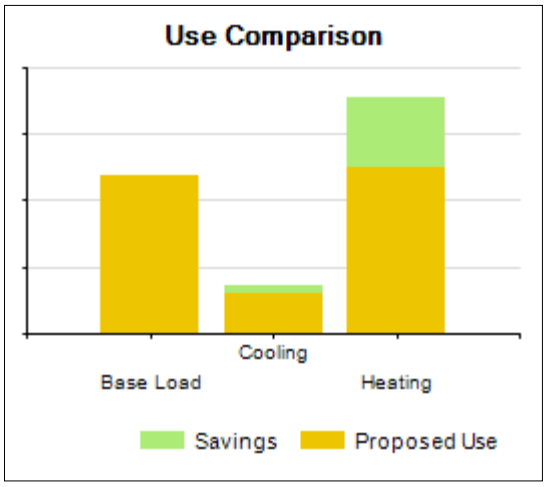
Audit Date: 3/14/2013

HOW YOUR HOME USES ENERGY

Fuel Type	Use	Unit Price	Cost	Savings
			$2,514	$583
Electricity	16882 kWh	$0.15		
	Total Cost		$2,514	$583







Heating usage includes all energy used to heat your home, similarly for cooling. They are both weather dependent. Base load is the energy use that is independent of the weather. This includes uses like appliances and lighting as well as hot water. This chart shows how your home is currently using energy among these different end uses. Each improvement affects the energy profile of your house in different ways. Insulation will improve both heating and cooling while replacing a refrigerator will only improve the base-load. This chart indicates the proposed energy usage of your house with all the recommended improvements installed to indicate from where your savings will come.

- Your overall electrical energy use for base load, heating, domestic hot water, and cooling is lower than most similar homes.
- This is attributed somewhat to the following observations that are not typical of most homes:
  - *Very low cooling related energy consumption.*
    - *In addition to an efficient cooling system, the home is passively cooled.*
    - *The orientation of the house on the lot allows for the southern and south western exposures to be shaded by deciduous trees during the summer that prevents the bedrock and stone and concrete features of the home from absorbing the suns heat.*
    - *The house is actually cut into the bedrock hillside at the right corner and rests on a concrete SOG that sits on top of bedrock and keeps the home cooler.*
  - *A previous air sealing effort in the Attic.*

REFER ALSO TO THE ATTACHED SEPARATE COMPARISONS PROVIDED ALONG WITH THIS REPORT.

- Department of Energy - Home Energy Score – Compares your home with similar types in the same area. Similar to a mph rating for an automobile.
  - Your score is 5 out of 10. According to this model, some of the reflected improvements that are included in the main report are included, and can improve the score to a 6.

- This score is better than usual for a home of this size, age, type of construction, because of the lower leakage rate, and your high efficiency equipment.
  - **It is important to understand that this model is <u>not</u> based on your specific energy use, but rather the broad characteristics of your homes construction and systems**.

- E.P.A. Energy Star Home Energy Yardstick – Compares your home to similar homes in the same area.
  - Your score is 6.6 out of 10. A typical home is 5.
  - This is based on your ACTUAL energy consumption for the period that was modeled compared to <u>national averages</u>.
  - ***<u>This is an excellent score that in addition to your thoughtful and conservative approach to energy consumption is also attributed to the previous comments regarding your efficient HVAC equipment, previous air sealing effort, and passive features of your home.</u>***

- **The properly calibrated model based on your actual energy use and the projected savings generated by the Compass/Surveyor software and the recommendations included in this report based on the specific observations and conditions of the home take precedence towards achieving energy savings and improving the comfort of your home.**

OTHER ENERGY SAVING OPTIONS FOR YOUR CONSIDERATION:

- An average household dedicates 11% of its energy budget to lighting.
- Using new lighting technologies can reduce energy use in your home by 50% to 75%.
- Using lighting controls offers additional energy savings by reducing the amount of time lights are on but not being used.
- Energy Star rated CFL's use about 75% less energy than standard lighting, produce 75% less heat (cut cooling costs), and last up to 10 times longer
  - Typically cost more than standard light bulbs, but typically will save about $30 or more in electricity costs over each bulbs lifetime.
  - They provide the greatest energy savings in fixtures that are on for the longest times each day.
  - CFL's contain a very small amount of mercury and must be properly disposed of. Most retailers offer free recycling services at their stores.
- The following Energy Star CFL Purchasing Guide is provided for your use.

LEARN MORE AT energystar.gov — CFL Purchasing Guide

My Fixture Has A/An…

Dimmer	You'll need a special dimmable CFL.
Three-way socket	You'll need a special three-way CFL.
Electronic control	Check with the manufacturer of your photocell, motion sensor, or timer.

What Color Would Work Best For My Use?

With CFLs you have options for your white light. Light color is measured on the Kelvin scale (K). As you see below, lower numbers mean the light appears yellowish and higher numbers mean the light is whiter or bluer.

Warm White, Soft White	Cool White, Bright White	Natural or Daylight
Standard color of incandescent bulbs.	Good for kitchens and work spaces.	Good for reading.
2700K – 3000K	3500K – 4100K	5000K – 6500K

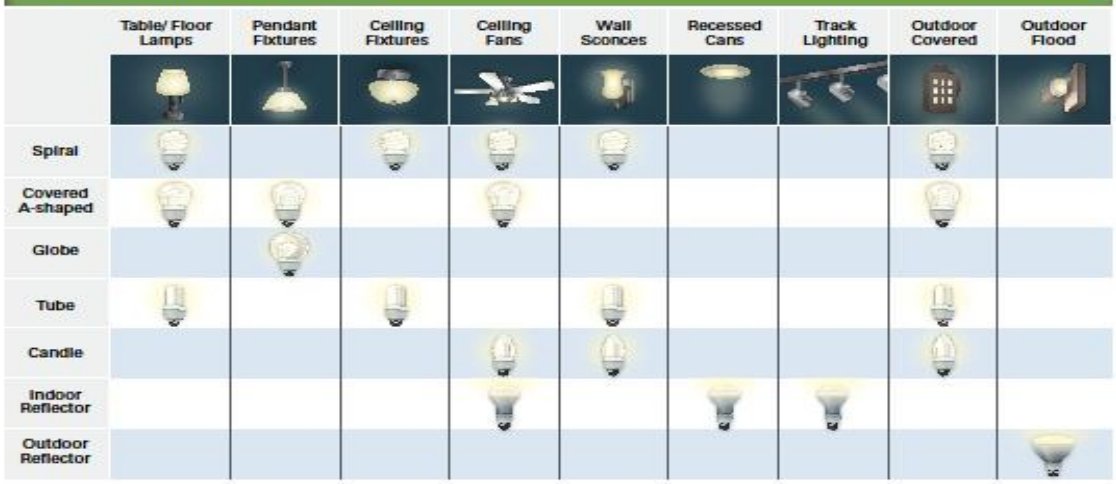
How Much Light Do I Want?

To determine which ENERGY STAR qualified light bulbs will provide the same amount of light as your current incandescent light bulbs, consult the following chart:

Incandescent Bulbs (watts)	Minimum Light Output (lumens)	ENERGY STAR Qualified CFLs (watts)
40	450	9 to 13
60	800	13 to 15
75	1,100	18 to 25
100	1,600	23 to 30
150	2,600	30 to 52

Notes: _____

How to Choose
the right ENERGY STAR® Qualified Bulbs



- An alternative to CFL's are LEDs.
  - Light Emitting Diodes (LEDs) offer better light quality than incandescent bulbs or CFL's.
    - This new technology is developing at a rapid pace.
  - They last 25 times longer than incandescent, and 3-5 times longer and use even less energy than CFL's.
    - Up to 80% less energy than an incandescent.
  - They produce almost no heat which helps reduce carbon emissions.
  - They typically generate 5 -7 watts when compared to a 60 watt incandescent.
  - They are best used at areas that only require directional lighting.

  - Some require the use of a special fixture, or a special adapter.
  - They cost more that both CFL's or incandescent, however they typically provide more savings over the life span of the bulb.
    - Typical costs per unit range $20.00 to $50.00 depending on the type.
    - A typical replacement for a 40 watt bulb like many of yours would cost around $20.00.
    - A typical replacement for a 65 watt recessed down light like yours would cost around $35.00.
- A link to a website is provided for your use.

www.ehow.com/facts_5548838_led-lighting-pros-cons.html

- A link to the Energy Star website for additional information regarding CFL and LED lighting technologies is provided for your use. Look under the Products section.

www.energystar.gov

- Electronics typically account for 5% of electrical usage.
- Use outlets that are controlled by wall switches to turn off the power to the device.
- Use Smart power surge protecting strips at major electronics that automatically shut down to eliminate phantom power loss.
  - These typically cost $40.00 - $60.00 a piece depending on what type you want.
  - These devices also have regular receptacles that will not shut down that can be used for electronics that you do not want to shut down due to loss of specific data or programming features such as a program guide, etc.
  - Get one with a wireless remote control for easier use.
  - **Energy Star studies show you can save $100.00 per year**.
- Use low flow aerators at faucets and showers to conserve water.
- Regularly vacuum the coils on your refrigerator to improve its performance.
- Purchase Energy Star models when replacement is necessary. The following link is provided for your use to research Energy Star products.

www.energystar.com

- The following link is provided for your use to research Smart strips, timers, etc.

www.chooserenewables.com

ELECTRICITY IN A DEREGULATED MARKET

- Deregulation presents opportunities for energy savings through various providers, but should not solely be relied upon to achieve energy savings, but rather as a compliment to using less and wasting less energy through the implementation of conservation strategies and home performance up grades.
- Consider obtaining electricity generated by an alternative source to coal through one of these sources at a similar rate to what you would normally be paying in a regulated market.
  - Refer to the following Off Site Alternative Energy section for more information.
  - Rates and plans vary. Be sure to research possible providers carefully in regards to cancellation fees, fixed or variable rates, etc.
  - Use this link to review the options that are available www.papowerswitch.com
  - Consider purchasing your energy through a "group buying plan" where energy is purchased by a large group from sources that offer an additional discount. May have limited enrollment periods.
  - For more details visit www.alphabuyer.com

LIMITED ALTERNATIVE ENERGY ASSESSMENT

On-Site:

SOLAR

- The previously referenced passive orientation on the lot that utilizes natural shading at the southern exposure of the home on the lot also limits the effectiveness of a solar system due to numerous tree obstructions.
    - A small solar panel was observed at the rear of the home.

GEOTHERMAL

- Because of the steeper grade, the rear lot is not large enough or reasonably accessible to consider a geothermal system in the future

Off-Site:

- **It is possible to purchase energy that is generated by alternative methods to fossil fuels.**
    - Every day activities many of us often take for granted, like heating and cooling our homes and driving back and forth to work each day rely mainly on fossil fuels that release harmful emissions into the atmosphere that have adverse affects on our environment.
    - Additionally, they contribute to our dependence on foreign oil, and endanger fragile ecosystems around the world as well as here domestically.
    - Renewable Energy Programs provide consumers with a way to support and help increase the development of new renewable energy sources that will reduce our collective reliance on fossil fuels. Additionally, they create jobs and help strengthen our economy.
    - There are various programs available that offer utility customers multiple choices that support the development of renewable energy generation projects at local, regional, or national levels where their utility providers either purchase the power directly from the producer, or purchase Renewable Energy Credits by developing or contracting with various alternative or sustainable energy producers such as Wind, Solar, Low Impact Hydro, Bio-fuels, Wave/Tidal, and Geothermal.
    - Green-e is a nationally recognized third party certification program for “green” power.
    - Using a Renewable Energy Program costs more than standard electricity but in a deregulated market often can be purchased at a lower cost than previously, or only slightly more than what a consumer is currently paying from their traditional utility company.

IMPROVEMENT SAVINGS

PROPOSED Improvement	Annual Savings	Lifetime (years)	Savings	Electricity Savings
Air Sealing	$234	20	0	1574 kWh
Above Grade Wall Insulation	$143	20	0	961 kWh
Window Improvement	$117	20	0	785 kWh
Attic Insulation	$88	20	0	594 kWh
Cooling System Equipment Improvement	$0	14	0	0
Heating System Equipment Improvement	$0	20	0	0
Improve Doors to the Exterior	$0	1	0	0 kWh

Homeowner Improvement	Status

- The worth of an improvement is not limited only to monetary ways.
- The value of improved comfort, indoor air quality and a healthier environment is a major consideration.
- Energy savings are repeated each year and will increase as energy costs increase.
- Several improvements have been recommended and included in this model to reflect a holistic approach of what your home needs so you can plan accordingly.
- It is not intended to imply that you need to immediately make all the improvements at the same time, but rather overtime.

YOUR PRIORITIZED TOP ENERGY SAVING MEASURES:

1. **Targeted Air Sealing (Attic, Garage, Improve Storm Windows, Miscellaneous).**
2. **Window Improvements. (Replace storm windows with Quanta Panels)**
   NOTE: Item 2 also count towards achieving the overall leakage reduction (item1). The generated savings listed separately above for these improvements are based on thermal improvement and are in addition to the Air sealing savings.
3. **Increase Attic Insulation.**
4. **Exterior Door Improvements.**
5. **Exterior Wall Insulation.** (Although this results in good savings potential, it is given a lower priority because of the higher cost and invasiveness associated with this improvement).

RESALE VALUE

- If you are considering selling your home in the future, promptly implementing the work, and keeping good records of the costs and energy savings will add value to your home, while immediately enjoying the benefits of improved comfort.
- According to the Alliance to Save Energy, energy-saving improvements **can increase the market value of your home by as much as $20.00 for every $1.00 that is reduced from your annual utility bills.**
- Using this as a standard of measure it may be possible for you to increase the value of your home by **$11,660.00** ($583 X $20.00) based on the adjusted savings predictions for all the improvements generated by the model.
    - A link to the website is attached for your use: www.energycheckup.com

OTHER INCENTIVES

- **The American Taxpayer Relief Act of 2012 that was recently passed by Congress provides extensions of energy tax credit provisions that benefit Homeowners seeking to do energy efficient improvements.**
- **Under Section 25C, Homeowners can claim a $500 maximum tax credit to cover material costs to upgrade existing homes.**
    - **The credit is only redeemable if the upgrades are in place by the end of 2013.**
    - Visit the following link for more information concerning eligibility requirements, etc: www.energysavers.gov
- A tax credit is subtracted directly from your total tax liability and is much more advantageous than a tax deduction which is subtracted from income before total tax liability is computed.
- Actual costs of the applicable materials used to support your tax claim are provided by the Contractor.
- Your local utility company (PECO) also has various programs that may be of interest to you.
    - Refer to information in the applicable sections for details.

Detailed recommended comprehensive energy saving improvements for your consideration as follows:

- **Not listed in a prioritized order.**

WINDOW IMPROVEMENT

Improve 19 Single With Storm windows to Double Pane (low-e) Quanta panels.

Detailed Improvement Properties

Existing Window Glazing	U -.49 & .71 SHGC
Proposed Window Glazing	U - .36 & SHGC - .45

- Most windows at all levels are the original wooden, single pane, clear glass, double hung types with exterior mounted aluminum storm windows.
    - Most storm windows are in poor condition.

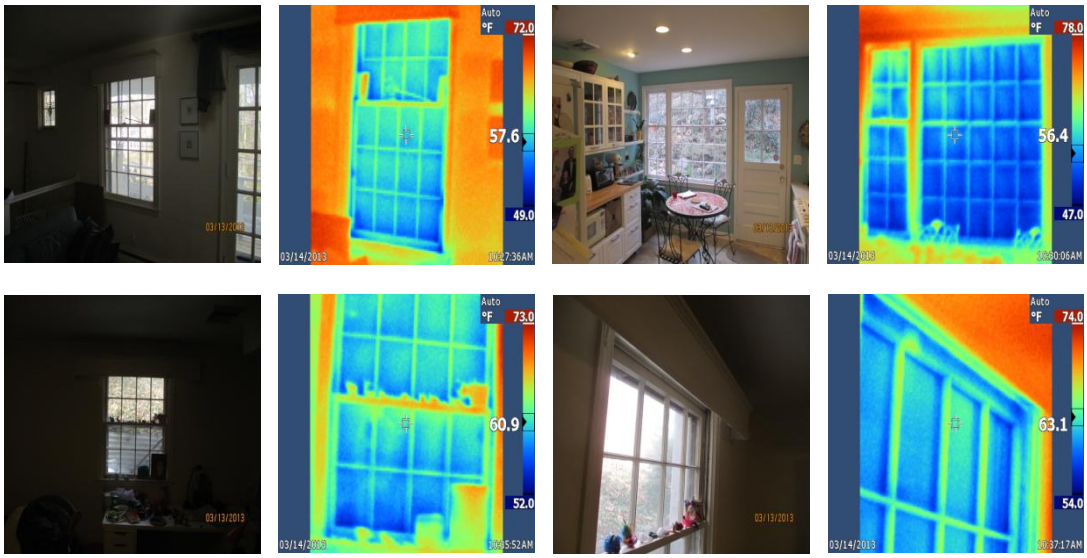
Storm window with cobwebs. Also sets at grade.

        - There are cobwebs and spider webs located between the outer storm windows and the main windows. This indicates that there is air penetrating the outer storm window.
            - Cobwebs were observed moving between the panes during the BD test that supports this.
- The windows located at the first level at the right side set at grade.
    - Consider installing a well, or replacing the lower part of the window with glass blocks, and an operable type at the upper portion.
- There is deteriorated trim at the exterior at the widows at the right side.

- The large fixed window at the rear of the house in the Kitchen does not have a storm window.
- There are 2 large single pane glass doors with outer glass storm doors located at the front elevation.
    - Leakage was observed at both the windows, and at the doors and at the step up from the floor during the BD test.
        - These windows are exposed to colder northerly winds.
    - Per BPI criteria, these doors are considered windows as they are over 50% glass and were factored as such in the related HEScore.
    - Refer to the Exterior Door Improvement and Miscellaneous air sealing sections for more

information regarding these and other doors.

- They are not included in the projected savings for this improvement.



TI's showing examples of infiltration and loss.

- Leakage was observed at most windows during the BD test.
  - Windows at the lower levels are a source of cold air infiltration.
  - Windows located at the upper floors are points of heat exfiltration.
    - This is reversed during the summer.
- **The generated savings are based on replacing the existing windows, or improving the thermal value of the windows to a U value of .36 & Solar Heat Gain Coefficient of .45 with the use of low e coatings.**
- Window replacement is an expensive improvement that has a long pay-back period.
  - Consider focusing on the windows at the front elevation that are somewhat exposed to cold northerly winds.
- **This improvement also contributes towards the overall leakage reduction by replacing the existing storm windows and installing Quanta Insulated Glass panels at the exterior side**.
    - This includes the large fixed window in the Kitchen.
  - This product was developed for use on the inside or the outside.
  - This product allows for a less expensive option that will result in similar savings and further decreased leakage would be to install Quanta Insulated Glass panels to improve the existing windows.
  - This product contains low e coatings and is installed like a traditional storm window.
  - Can be installed at ½ - 1/3 the cost of a window replacement.
  - This product has successfully reduced leakage at windows (in addition to increasing U value) as observed during Quality Assurance Test outs.
  - Visit www.quantapanel.com for additional information.
- **All windows should be properly caulked at both the inside and exterior regardless of selected replacement.**

COOLING SYSTEM DATA - NO IMPROVEMENT

Cooling System Equipment Data – 2012 Goodman Energy Star rated Air Source Heat Pump

Cooling Equipment Capacity	48,000 BTU – 4 ton unit
Cooling Equipment Efficiency	14 – 15 SEER
Cooling Equipment Type	Air Source Heat Pump - Ducted

HEATING SYSTEM DATA - NO IMPROVEMENT

2012 Goodman Energy Star Rated Electricity Air Source Heat Pump - Electric Backup Ducted.

Detailed Improvement Properties

Heating Equipment Capacity	48,000 BTU
Heating Equipment Efficiency	8.25 HSPF
Heating Equipment Fuel	Electricity
Heating Equipment Secondary Efficiency	0
Heating Equipment Type	Air Source Heat Pump - Electric Backup Ducted

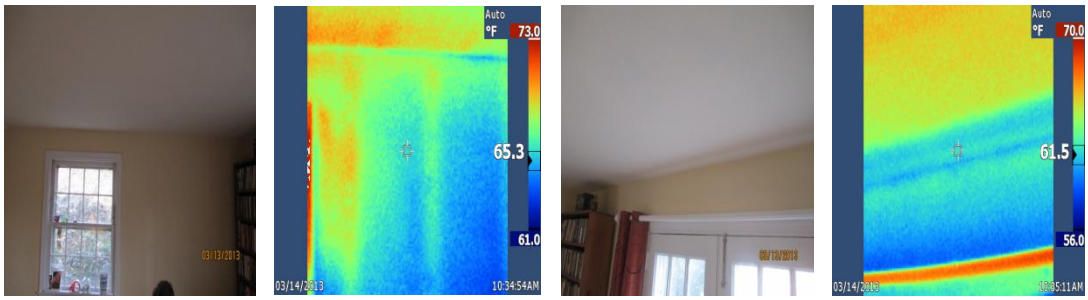
ABOVE GRADE WALL INSULATION AT LOWER LEVEL

Above Grade Wall Insulation (624 sq ft) – **Pertains only to the 3 exterior walls at the lower level that are constructed out of masonry.**

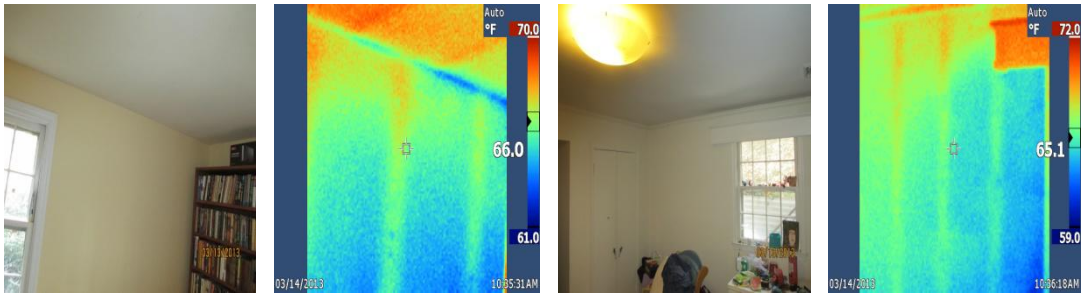
Detailed Improvement Properties

Existing Wall Insulation Depth (inches)	0
R-Value of existing wall insulation	R3
R-Value of proposed wall insulation	+R6 - R7
Thickness of proposed wall insulation	1”

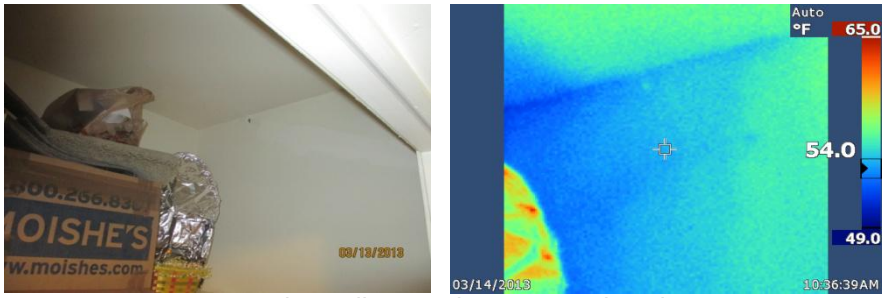
- Exterior walls at the mid and upper levels are wood framed with 3.5” of fiberglass insulation (loose or rolls).
- The wall at the lower level that separates the conditioned space from the unconditioned Garage is insulated with 3.5” of loose fiberglass insulation.
- The inspection and thermal images indicate the narrow wall cavities between the vertical furring and plaster finish at the exterior masonry walls located at the lower level are not insulated.
- This cavity allows for the opportunity to pressure inject 2 part foam insulation (Insul Smart Resin or similar retrofit foam) into 1" vertical cavities behind the plaster at masonry walls.
    - Consider using soy based "green product" that has no off gassing to achieve 0% ozone depletion.
- These products will provide thermal values of R6 –R8 to the un-insulated cavities.
- **The estimated savings for this improvement are based on this using this method only at the 3 exterior sides located at the first level.**
- These applications will also eliminate loss via the stack effect at the open cavities and will further decrease the leakage rate beyond the reduction currently factored into the air sealing savings predictions that will result in additional yearly savings and improved comfort.
- These applications typically require that 2 small holes (around 2") be made in the plaster finish at each bay between the furring to inject the insulation.
- The holes will be patched by the Contractor after the injection.
- It will be necessary to restore the finishes after the holes are patched.
- **Consult with a Contractor specializing in this application for more details.**



Exterior wall at lower floor elevations and TI at same location.



Exterior wall and TI at same location.



Exterior walls at and TI at same location.

- Another option to improve the insulation at exterior walls would be done as part of a future exterior siding replacement.
    - The existing cementitious fiber siding at the exterior is in fair to poor condition and should be considered to be budgeted for replacement in the future.
    - **It is possible that the composite siding could contain friable asbestos material.**
        - **The material should be tested by an environmental testing company prior to removal if applicable.**
    - Replacing exterior siding allows for the opportunity to increase the thermal value of the exterior walls by installing a rigid ½" – 1" poly isocyanurate (R7) or 1" expanded/extruded polystyrene (R4-R5) insulation board over the existing substrate once the old finish is removed.
        - Joints should be sealed with cold weather tape.
        - This will also generate additional air sealing reduction in addition to thermal value.
    - Additional thermal value of R3 - R5 can be achieved by installing ½" insulated vinyl siding as the new finish in addition to the 1" rigid board, or by itself alone.
    - The use of R7 rigid and R5 insulated siding will increase the thermal value of the walls by R12 and generate additional savings.

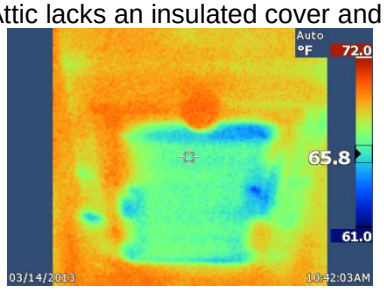
ATTIC INSULATION - BOTH LEVELS

Improve 1,428 sq ft of attic floor insulation.

Detailed Improvement Properties

Existing Attic Insulation Depth	350 SF – 9” fiberglass in fair condition, 364 SF -5”-6” loose rock wool and/or fiberglass at upper attic, 714 SF 2”-3” loose RW/FG with 6” FG on top at lower attic.
Proposed depth of Attic Insulation in inches	Varies as indicated.
R-Value of existing attic floor insulation	UA Average R20
R-Value of proposed attic floor insulation	Minimum of R40-R42. Varies as indicated.

- **Completing the remaining Air sealing recommendations at this space MUST be completed prior to improving the insulation in order not to undermine its effectiveness.**
- Insulation was missing or observed as "black" at locations adjacent to remaining unsealed joints at exterior top plates, top plates and unsealed parts of the bottom at the vertical transition wall that connects the 2 levels, and unsealed duct, etc penetrations as a result of being displaced or dirt being deposited via air flow.
- The drop down access door and stairs to the upper Attic lacks an insulated cover and a tight seal.



Loss at access stairs.

- The Attic floors are constructed of 2x6 joists at 16” on center.
- Some of the upper Attic is used for storage and is covered with plywood deck adjacent to the drop down access stairs that also accommodates an air handler.
- Half the floor (350 SF) at the upper level is insulated with 9” fiberglass compressed into the 6” cavities and is in fair condition.
  - The overall weighted average effective R value of the insulation is estimated to be R16.
- The other half (364 SF) with 5”-6” of mixed loose rock wool and fiberglass.
  - The overall weighted average effective R value of the insulation is estimated to be R15.



Storage deck and conditions at upper Attic.

- The insulation at the lower attic is 2”-3” mixed loose rock wool and fiberglass covered with 6” rolled fiberglass on top of it.
    - The overall weighted average effective R value of the insulation is estimated to be R23


Conditions at lower Attic.

- **The UA Average of the 3 different values across the total area is R20.**
    - This is less than the recommended minimum of R38 - R40 for this region.

- The vertical wall connecting the 2 different levels is insulated with 2” of rigid board.
    - Refer to comments in the Air Sealing section of the report concerning this wall.
- There is an air handler and flexible insulated ducts throughout the spaces.

- **The predicted savings are based on increasing the level of insulation to a minimum of R40-R44 by**:
    - Replacing, or supplementing the existing loose insulation with new insulation as follows:
        - 11”-14” loose cellulose to R40 – R51.
        - 15” – 16” loose fiberglass to R42 – R45.
            - Consult with product manufacturer or Contractor about the need for a vapor barrier with these products.
        - New or properly re-installed 6” fiberglass batts with KP towards ceiling in cavities (R18) and then covered with a layer of 8” – 12” faceless fiberglass perpendicular to the joists on top (R24) for R42. –R48.
            - Some of the existing 6” and 9” fiberglass insulation in better condition could be reused.
    - Consult with the Contractor regarding any savings benefits of re-using any insulation in relation to the labor.
- All insulation must be in contact with the ceiling below and remain loose and not compressed to achieve best performance.
- **The drop down stairs should be fitted with an insulated cover constructed out of 2” closed cell rigid board, or a pre-manufactured type that can easily be lifted out of the way during entry**.
    - The perimeter of the door, or edge should be weather-stripped and thumb-turns or other device be installed to provide a tight seal.
- Accessible recessed lights should be sealed and insulated with fire retardant Tenmat cellulose covers, or a

similar product to eliminate loss at these locations.
    - These typically cost about $20 each and can be obtained through your Contractor or online.
- Because of the darker colored shingles, and higher clearance in the Attics, other options would be:
    - To install a thermal reflective barrier such as eShield ULTRAMAX SUPER R to the underside of the roof rafters.
        - This product works enhances your existing insulation and stops 97% of radiant heat transfer.
    - Apply a thin coat of radiant-barrier spray to the underside of the roof deck.
        - This product can block up to 75% of the suns radiant heat from entering through the Attic.
- The Attic is ventilated via ridge vents at each roof level, and perforated soffits at the overhangs at the front and rear, and louvered vents at the gable sides.
    - **Rafter vents should extend a minimum of 1'0" above the top of increased insulation.**

AIR SEALING

Reduce the house air leakage from 2665 CFM50 to 1732 CFM50.

Proposed Infiltration (CFM50) 1732

- **<u>These improvements are considered your top priority and will result in significant improved comfort and reasonable yearly savings.</u>**

BLOWER DOOR TEST (Also refer to the Measurements Section for additional information)

- The results of the inspection, Thermal Images, and the Blower Door test indicate that a "targeted" air sealing effort that addresses the following issues will result in reasonable energy savings, and greatly improve comfort.
- Some current was observed at the stairs that connect each level of the house during the BD test.
- The recorded leakage rate of 2665 cfm is considered "typical" per the BPI scale, and is much better than most typical homes of this age and construction type.
    - This is attributed to a previous air sealing effort at the Attic.
- Your home is unusual in regards that it is tighter than most, but the remaining unaddressed areas are often the source of the communicated comfort issues.
- **<u>Using ASHRAE 62.2 Whole House Ventilation standards, there is an 1663 cfm delta to air seal the home to the BAS level of 1002 cfm.</u>**
        - Based on cfm 50 = cfm Nat x N.
        - cfm natural per the ASHRAE 62.2 - 2010 chart = 60
        - N = 16.7 – 1.5 story (split level) normal exposure per the Appendix A12 of the Residential Energy Index
        - **BAS cfm 50 = 60 (16.7) =1002 cfm 50.**

- **<u>The savings projected in this report are based on reducing the baseline leakage rate by 35% to 1732 cfm using this method.</u>**
    - *An updated version of this standard is expected to replace the current BPI standard of ASHRAE 62.89 sometime later in 2013.*

- **Blower Door guided air sealing is strongly recommended to insure that leaks are addressed and the BAS is closely monitored.**
- The Test out Analyst will review the actual reduced Blower Door reading in relation to ASHRAE 62.2 protocol regarding minimal natural ventilation.

FOR REFERENCE & COMPARISON:

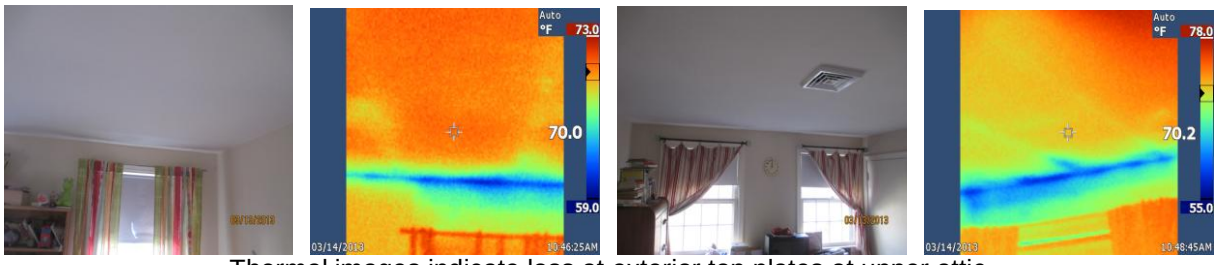
- **WHEN COMPARED TO THE CURRENT BPI *ASHRAE 62.89* minimum ventilation standard there is only a 678 cfm delta to air seal the home to the BAS of 1987 cfm. (119 CFM Nat X 16.7)**
  - Based on 20,464 CF of volume (2558 SF x the 8' ceiling height).
  - ACH CM Natural is .47. This is slightly higher than the .35 ACH typically required**.**
  - **Using this standard would require that leakage rate does not exceed 70% of the BAS and the appropriate amount of make-up ventilation air be provided via mechanical ventilation.**
    - Although this is not mandatory, the recommended "Best Practice" motto for constructing and air sealing a home is "seal it tight and ventilate it right".
    - A mechanical ventilation system with a HVR (Heat Recovery Ventilator) can reduce operational costs which are reasonably low to begin with.
      - Typical costs for these systems range from $800 - $3000.
      - Visit www.Aprilaire.com for more information on this product.
      - Consult with an HVAC Contractor regarding this matter.

ATTIC AIR SEALING (The "Top"- Reduces exfiltration of conditioned air via the "stack effect".) (Pertains to both the "upper"and "lower" attics.) This is your top priority.

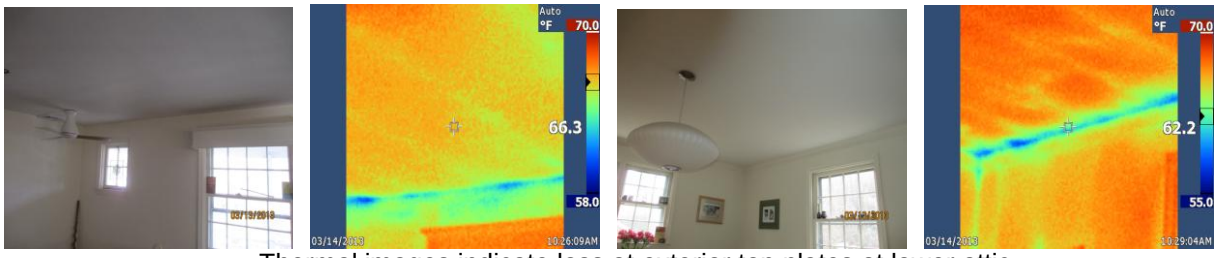
- Overall the attic spaces are reasonably sealed at interior top plates, gable top plates, and many penetrations.

Examples of sealed top plates and penetrations.

- Thermal images indicate loss at unsealed exterior top plates connected to the attics.
- Black insulation was observed at exterior top plates and some unsealed penetrations indicating that dirt and fines are being deposited in the material as air is passing through it.



Thermal images indicate loss at exterior top plates at upper attic.



Thermal images indicate loss at exterior top plates at lower attic.

- The vertical wall that connects the 2 levels has been sealed with 2" rigid board, but the top plates are not sealed, there are breaks at the bottom perimeter and unsealed joints, and there is a large by pass where this wall intersects with the drop soffit located in the Kitchen.
    - Significant leakage was observed at the recessed lights in and adjacent to this area during the BD test.

Unsealed top plates, joints, and breaks in the vertical wall at Kitchen soffit connecting the 2 attics.

- Leakage was observed at the attic access, recessed lights, some duct, and exhaust fan penetrations during the BD test.

Examples of unsealed chimney and duct penetrations and TI showing example of loss at a RA vent.

- Air transported heat loss through the Attic leads to roof deterioration and structural failure over time.
    - Warm air condenses on the cold underside of the roof deck which causes rot, shingles to curl and mold.
- It will be necessary to temporarily relocate and reinstall the existing insulation to effectively facilitate the work.
    - Coordinate this work along with any insulation improvements as necessary.

- Use closed cell foam (GATS, Hilti systems, closed cell Spray foam insulation, or Great Stuff) to seal the following locations:
    - Seal all top plates at exterior walls.
        - It may be necessary to use an “extension wand” in order to reach the top plates because of the tight angle of the roof rafters.
    - Seal applicable penetrations for fans, wires, pipes, etc, through the attic floor or top plates.
    - Seal all top plates and applicable penetrations at the vertical transition wall.
- Seal the open top of the Kitchen soffit with closed cell rigid insulation board, and seal (infill where missing) any open parts of the vertical transition wall with 2” rigid board and seal the joints with foam.
- Infill any missing locations at the bottom of the vertical wall, and seal all joints at the existing rigid board with UL cold weather tape and/or foam.
- Refer to comments in the Attic insulation section regarding sealing and insulating recessed lights and the access panel.

GARAGE

- The wall between the spaces is insulated with loose fiberglass in the cavities (does not appear to be dense packed), but the bottom perimeter joint at the conditioned side is not sealed.
- The floor above the Garage is insulated with loose fiberglass (does not appear to be dense packed), but there are some unsealed penetrations
- There are also several unsealed penetrations thru the wall for wires, abandoned ducts, etc, and gaps in the drywall at the closet that is connected to the wall and abandoned ducts.
    - Also refer to the following Miscellaneous Air sealing section for photos and information regarding issues in the closet as well as the door to the Garage.

Examples of joints and penetrations that need sealed in the wall connected to the Garage or in the Garage ceiling.

- Prepare surfaces by cleaning and removing loose dirt, etc (vacuum).
- Seal all penetrations and joints with closed cell foam or silicone based caulk.
- Seal with foam and/or cap the abandoned metal ducts through the wall.

MISCELLANEOUS

Interior:

Leakage was typically observed at the following locations throughout during the BD test:

- At baseboards at the Garage wall at the entry foyer, at holes, gaps, and penetrations in the wall, and at gaps, etc at the closet adjacent to the Garage wall.

Examples of unsealed penetrations at Garage wall, baseboards, and gaps at closet door trim.

- Seal penetrations, gaps, and baseboards with foam, joint compound, or silicone based caulk.

- At the joints at the stone above the front entry door wall, and at the joint at the stone ledge next to the planter by the stairs up to the first level.
  - Seal with silicone based caulk.

- At joints at the treads and risers of all stairs to the different levels.
  - Seal with clear silicone caulk.

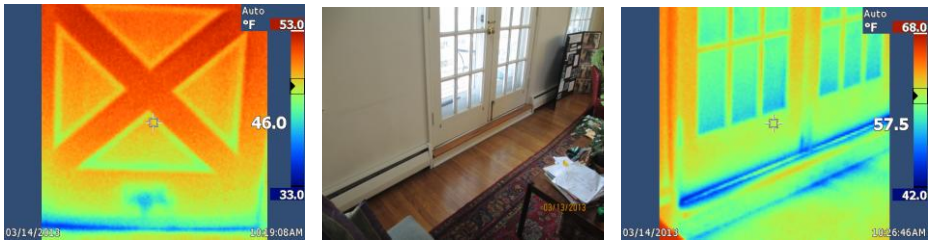
- At the perimeter ceiling joints and penetrations at the Laundry area, and the joint around the chimney.
  - Leakage at these areas originates at the concealed perimeter band joist.
- At pipe penetration and baseboard at Laundry sink.

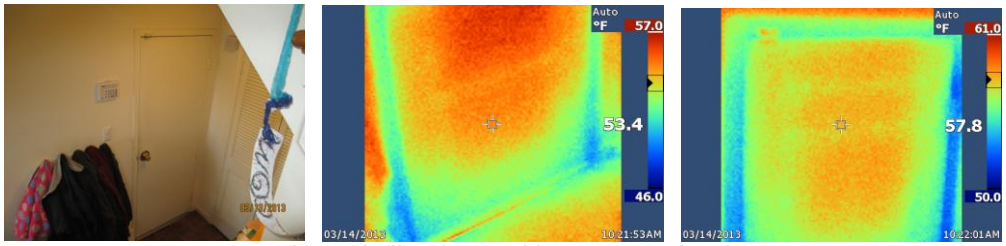
Examples of infiltration and loss at unsealed joints and penetrations in the Laundry area.

- Seal all penetrations with foam or silicone based caulk.

- At most windows throughout.
  - Also refer to the Window Improvement section regarding the installation of Quanta Insulated panels.
  - Remove deteriorated caulking, prepare/clean joints, and apply new silicone based caulk.

- At the perimeter of the front entry, both glass doors to the deck, rear doors to the exterior, and door to the Garage.





Examples of infiltration and loss at exterior doors.

- Replace all deteriorated weather-stripping and bottom seals.
- Seal all joints at the steps at the glass French doors to the deck and front with silicone based caulk.
- Also refer to the Exterior Door Replacement section.

- At the abandoned radiator at base of wall in the Home Office and at the joints at the step to the door.
  - Seal with silicone based caulk.

- At the baseboard and pipe penetration for the sump pump in the rear BR closet.

  - Seal with foam and/or silicone based caulk.

- At all recessed lights at the mid level.
  - Ideally these will be sealed and insulated with Tenmat covers in the attic.
  - An alternative if they are not accessible is to seal them <u>from the inside</u> as follows:
    - Remove the trim ring and lamps.
    - Cover all slots, holes, etc inside the can with duct seal material rated for electrical applications.
    - Caulk the perimeter joint between the fixture and ceiling, and then reinstall the lamps (replace with CFL's to reduce heat) and caulk the trim with silicone based caulk.

- At baseboards at exterior walls where the perimeter rim is not easily accessible.
  - Seal the joints with silicone based caulk.
    - Ideally the baseboards should be removed to allow the larger joint behind it to be sealed.
    - The baseboard joints should also be caulked after it is re-installed.

- In addition to sealing any remaining wire penetrations at Attic spaces, install fire retardant gaskets at all electrical devices and child proof inserts into unused receptacles throughout.

Exterior

- Remove deteriorated caulk as applicable and re-caulk penetrations, or seal with foam and/or caulk poorly or unsealed penetrations and perimeter window joints with exterior grade silicone based caulking.



Examples of deteriorated seals at penetrations.

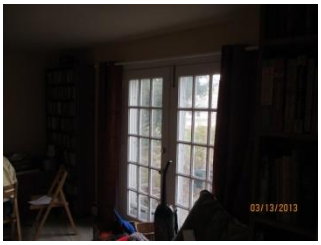
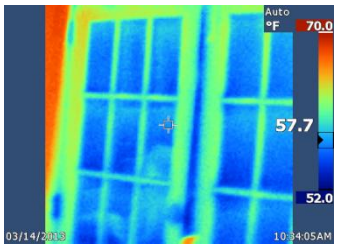


Examples of deteriorated caulk at windows.

EXTERIOR DOOR IMPROVEMENTS

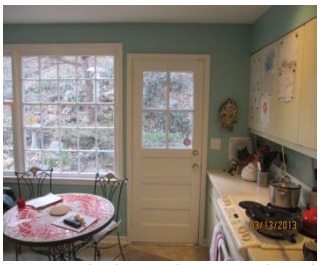
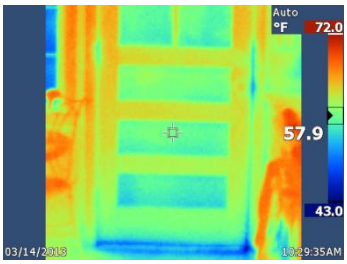
Improve 3 Doors to the Exterior

- No specific savings could be generated for this improvement because there is no input for the smaller size of the doors in relation to the much larger exterior thermal barrier.
- **Budgeting to replace the double door to the exterior at the lower level Home Office, and the 2 rear doors to the exterior from the lower and mid levels is recommended to eliminate infiltration and loss at these locations.**
- The two double glass doors with outer storm doors at the Home Office and to the front deck at the mid level are exposed to cold northerly winds and are a source of cold air infiltration.
    - This type of door works better at the deck location where vision to the other side is important.
    - The door at the HO should be replaced with a more appropriate door should this room be used as a Bedroom in the future.
        - Especially if you decide to pressure inject the exterior walls adjacent to this location.
        - Reducing the size of the door at the HO to a single door, or replacing the door with a smaller window is another consideration as part of a larger project.

Infiltration and loss at glass doors at Home Office.

- The exterior door to the rear from the Kitchen is a poorly insulated solid wood panel type in poor to fair condition, has a large single pane glass window, a storm door, and has poor weather-stripping.
    - Thermal images indicate that this door is a source of cold air infiltration and loss of conditioned air.
    - This door should be budgeted for replacement in the future.

Kitchen door and TI indicating infiltration & loss.

- The exterior door to the rear from the Laundry is a poorly insulated solid wood panel type in poor to fair condition, has a large single pane glass window, has no storm door, and has poor weather-stripping.
    - This door should be budgeted for replacement in the future.
- **Replace these doors, and any others in the future with Energy Star rated types with factory installed weather-stripping and integral threshold.**
    - The threshold should set in a ¼" bed of silicone.
- At the minimum:
    - Improve the doors by replacing the weather-stripping, threshold and/or door sweep, and caulk perimeter of the doors at both sides.
    - Install a storm door at the Laundry location and install weather-stripping, threshold and/or door sweep, and caulk perimeter of the door at both sides.
    - Also refer to the Miscellaneous Air Sealing section for more information related to exterior doors.

HEALTH AND SAFETY MEASUREMENTS

BLOWER DOOR TEST RESULTS

Method	Whole Building Mechanical Ventilation – ASRAE 62.2 - 2010
Building Pressure (Pa)	-50
Fan Pressure (Pa)	50
Fan Ring Used	A+B Rings
Building Leakage (CFM50)	2665
Building Airflow Standard	1002
Result	Pass
Action	Refer to comments in the Blower Door part of the Air Sealing section.

STOVES

Fuel	Electricity
Carbon Monoxide (ppm)	0
Vent Out	false
Action	

AMBIENT CO

Kitchen (ppm)	0
Living Room (ppm)	0
Other (ppm)	0

DISTRIBUTION SYSTEM AIR FLOW

Test Results	Pass
Action	NO DUCT TESTING PERFORMED. No too little leakage was observed at vents during the BD test.

COMBUSTION APPLIANCE ZONES

Zone Description	N/A – All Electric Appliances
Baseline Depressurization (Pa)	N/A
Worst Case Depressurization (Pa)	N/A
Net Depressurization (Pa)	N/A
CAZ Limit (Pa)	N/A
CO Ambient (ppm)	N/A
CAZ Result	N/A
Action	N/A

Worst Case

Equipment	**Spillage / CO / Flue Draft**
DHW	N/A / 0 ppm / 0 Pa
Other	N/A / 0 ppm / 0 Pa
Primary Heating	N/A / 0 ppm / 0 Pa
Secondary Heating	N/A / 0 ppm / 0 Pa

Natural Condition

Equipment	**Spillage / CO / Flue Draft**
DHW	N/A / 0 ppm / 0 Pa
Other	N/A / 0 ppm / 0 Pa
Primary Heating	N/A / 0 ppm / 0 Pa
Secondary Heating	N/A / 0 ppm / 0 Pa

Flue Inspection

Equipment	**Result**
DHW	N/A
Other	N/A

Primary Heating	N/A
Secondary Heating	N/A

DUCT LEAKAGE

Test	No Duct Testing Performed
Result (CFM25)	0
Pressure Pan Avg (Pa) Test In	0
Pressure Pan Avg (Pa) Test Out	0

VENTILATION

Primary Heating Vent Type	N/A
DHW Vent Type	N/A
Gas Leaks Detected	N/A
Gas Leak Notes	
Gas Dryer Flue	
Dryer Vent	Electric
Dryer Vent Action	None
Other Health & Safety Issues	1. Some mold observed under sink in Laundry from past leak. Cut away contaminated material and/or apply mold killer.