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# ENERGY CASE STUDY

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## 71 Mountain Terrace, Bristol



Located at the very end of Mountain Terrace in Bristol, this 2288 sq. ft. home was built in 1986.

Mike Leyden and Sara Granstrom's Bristol home located on Mountain Terrace.

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### Status in June, 2018:

After renting the house for a couple years, Mike and Sara bought the house in June and began to ascertain what needed to be done to make it more energy efficient and comfortable. Nate Gusakov of Silver Maple Construction, LLC was engaged to perform a full home energy audit and the related work. This audit included:

- Combustion safety testing of boiler and gas range/oven
- Whole house testing/monitoring for CO and combustible gas leaks
- Inspection of building envelope details throughout
- Blower-door air leakage testing
- Thermal imaging

- General inspection of foundation, house structure, siding, trim, roof, and interior 1 finishes for safety and integrity.

### Results of the Energy Audit:

Home Heating Index (HHI) is a common way of comparing homes heated by fossil fuel. It takes into account the size of the home (ft<sup>2</sup>), the total amount of heating fuel used annually (Therms), and the local climate (Heating Degree Days).

This house’s HHI over the preceding 12 months was: 5.3, which means "Moderate to Average." Improvements could be made!

- Infrastructure in place: The previous owners had installed a high-efficiency heat pump hot water heater, disconnecting domestic hot water from the boiler.
- The heating system relies on forced hot water via a 32 year-old New Yorker fuel oil-fired boiler with an AFUE of 84%. It is need of eventual updating/replacement.

### Thermal Boundary: Insulation

Insulation is measured using ‘R-value’. R-value is the ability of a material to resist heat flow. As the R-value of a home’s insulation increases, winter heat loss is reduced. Component R-Values below are taken from: The Vermont Residential Building Energy Code (RBEC) and Efficiency Vermont’s Certified High Performance Home (CHPH) requirements.



The chimney chase was implicated in air leakage.

HOME COMPONENT	Your Current R-Value	RBEC / CHPH
Basement Walls	<b>R-17.5</b>	R-15 / R-30
Above-ground Walls	<b>R-10.5</b>	R-25 / R-40
Attic/Ceilings	<b>R-21</b>	R-49 / R-60

### Air flow Results:

Air Changes per Hour at Natural pressure (ACH<sub>n</sub>) is a number that represents how many times per hour the total volume of air in your house is completely replaced with air leaking in from outside. It is derived from the blower-door test. For example, a home with an ACH<sub>n</sub> of 1.0 would exchange 100% of its air every hour. A home with an ACH<sub>n</sub> of 0.5 would exchange 50% of its air every hour.

## ACHn Interpretation:

0.04 ACHn – Extremely tight, e.g. a certified Passive House

0.35 ACHn – Very tight, mechanical ventilation needed

0.41 ACHn – Fairly tight, small improvements can be made

— — — **During audit: house measures 0.48 ACHn** — — —

0.6 ACHn – Somewhat leaky, significant improvements possible

1.0 ACHn – Extremely leaky

## Work Plan:

- Augment attic insulation to R-49 with 8" loose-fill cellulose (~560 sq.ft)
- Apply 2" foil-faced polyisocyanurate foam insulation (fire-rated, taped joints) to the back side of 2nd floor 'crawl space' walls (~300 sq. ft)
- Add spray-foam insulation to any small spots on basement interior wall that are lacking
- Air seal: around chimney chase in basement & attic; all attic penetrations at ceiling plane; all outlets on exterior walls; address kitchen range hood leakage; install one-way damper to 2nd floor bath fan ductwork (target 35% leakage reduction)
- Perform test-out with blower door; provide all necessary documentation to Efficiency Vermont rebate program



Additional cellulose added to attic.

## Other related upgrades:

Installation of two Panasonic Whispergreen Select bathroom ceiling fan/light combo units that will provide ASHRAE-rated ventilation.

## Results:

Air Leakage reduction target: 35%

Achieved: **50% reduction in air leakage!**

## Cost Savings and Comfort:

We have every expectation that between the added insulation and reduction in airflow/ leakage, we will see a reduction in heating costs.

During the recent warm summer, the effects of added insulation were noticeable in that the upstairs stayed cooler than previous summers. During the modest cooling off seen thus far this autumn, we are able to set the thermostat slightly lower and note that the boiler has to run less frequently to maintain the set temperature.