

Final Assignment

Executive Summary

The house was built in 1956. It is a single family home. The total finished space is 2167 square feet. The purpose of this audit is to see how we can help you save energy and money through your house. My first recommendation if you want to see some faster changes made for little cost is to change some of your appliances, ducts and lighting so you have more efficient energy star appliances, 7.5% leakage, R-6 ducts, and have 100% fluorescent, hardwired and plugin lighting. The cost to do this should only run a couple thousand dollars more than what you have now. My second recommendation is to change your windows to triple pane, low-gain low-e, insulated frame, argon fill, which can cost about 25-30 % more than the windows you have now, and to change air leakage from 10 ACH50 to 1 ACH50, which can cost almost 4 times what you have now. Triple pane windows can be costly, so my third recommendation if triple pane windows are too expensive is to find something in between the first two recommendations by changing your windows to double pane, low-gain low-e, insulated frame, argon fill, which only costs about 2 times the amount you have now, change air leakage to 1 ACH50, change some of your appliances, such as your refrigerator and washer, so they are more energy efficient, change your ducts to 7.5% leakage, R-6 ducts so there is less leakage, and change lighting to have 100% fluorescent, hardwired and plugin so the lighting is more efficient and there is less electricity usage on lighting. Doing the third recommendation should only cost a few thousand more than you have now and doing these things will be more cost effective and energy effective.

Energy Action Plan

You should consider what changes and improvements you want to make and start saving money to be sure you can afford the improvements being made, or look into loans or programs that can help you pay for the costs.

Energy Financing Options

Homeowners can get financing through loan programs to help pay for the costs of making your home more energy efficient. One program is through an organization called Michigan Saves. They offer up to \$30,000 in financing to homeowners with no home appraisal or equity required and at a fixed annual percentage rate of 7% (Homeowners). Through them, homeowners can choose from a list of improvements such as new windows and doors, new air conditioners or furnaces, or even new appliances. You can also get a home energy assessment to identify what you can do to spend less money on energy in your home. All you need to do is find an authorized Michigan Saves contractor to get an estimate, complete the loan application, and once the loan is approved, the contractor can make the improvements (Homeowners).

Maintenance Recommendations

You should maintain your equipment to prevent future problems and unwanted costs. A typical maintenance check-up should include the following.

Check thermostat settings to ensure the cooling and heating system keeps you comfortable when you are home and saves energy while you are away.

Tighten all electrical connections and measure voltage and current on motors. Faulty electrical connections can cause unsafe operation of your system and reduce the life of major components.

Lubricate all moving parts. Parts that lack lubrication cause friction in motors and increases the amount of electricity you use (Maintenance Checklist).

Check and inspect the condensate drain in your central air conditioner, furnace and/or heat pump (when in cooling mode). A plugged drain can cause water damage in the house and affect indoor humidity levels.

Check controls of the system to ensure proper and safe operation. Check the starting cycle of the equipment to assure the system starts, operates, and shuts off properly.

Cooling Specific

Clean evaporator and condenser air conditioning coils. Dirty coils reduce the system's ability to cool your home and cause the system to run longer, increasing energy costs and reducing the life of the equipment (Maintenance Checklist).

Check your central air conditioner's refrigerant level and adjust if necessary. Too much or too little refrigerant will make your system less efficient increasing energy costs and reducing the life of the equipment.

Clean and adjust blower components to provide proper system airflow for greater comfort levels. Airflow problems can reduce your system's efficiency by up to 15 percent (Maintenance Checklist).

Heating Specific

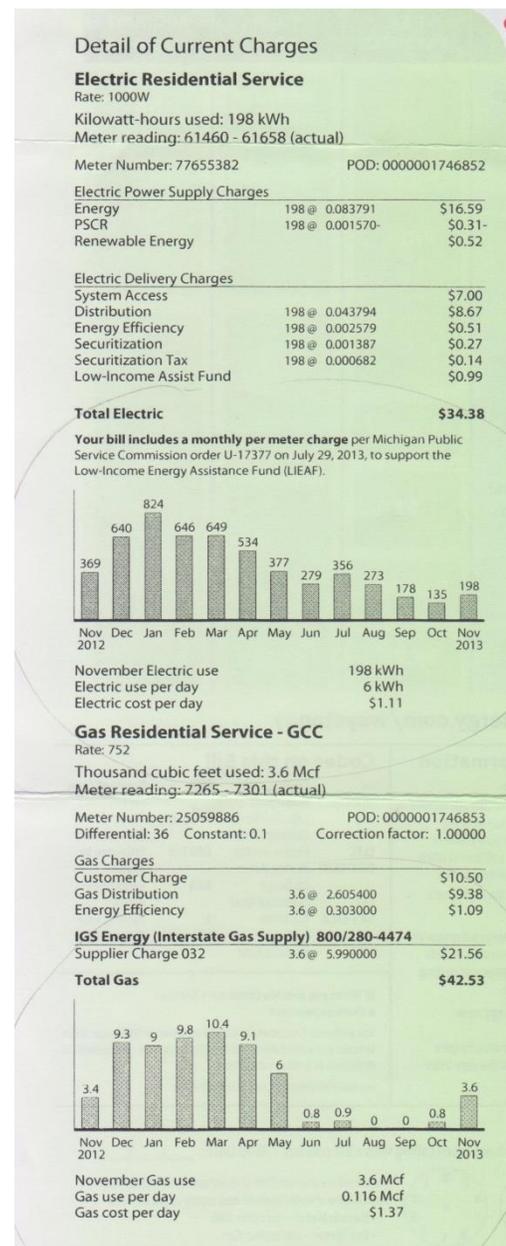
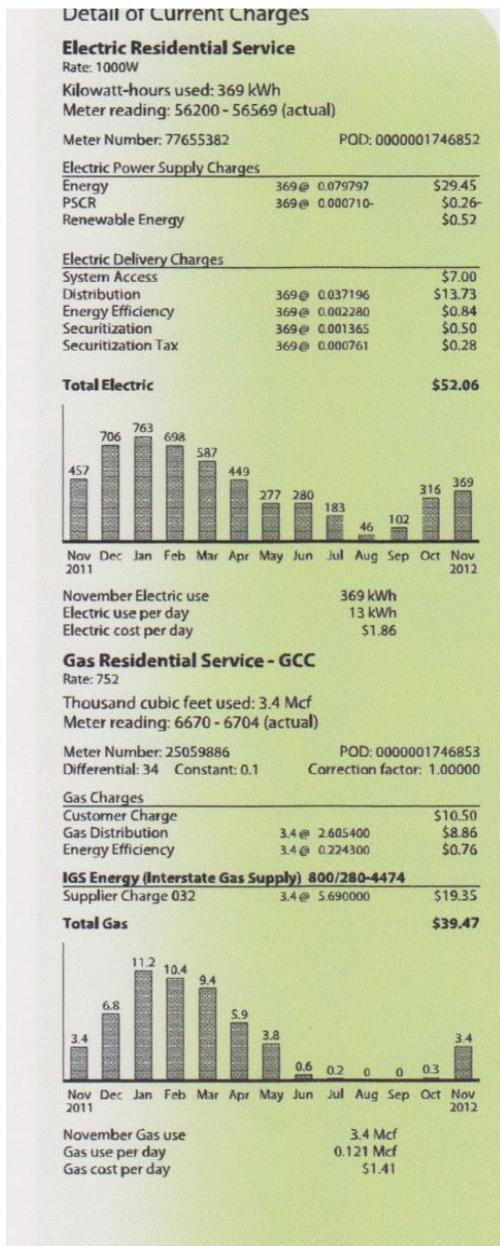
Check all gas (or oil) connections, gas pressure, burner combustion and heat exchanger. Improperly operating gas (or oil) connections are a fire hazard and can contribute to health problems. A dirty burner or cracked heat exchanger causes improper burner operation. Either can cause the equipment to operate less safely and efficiently.

Actions To Do Yourself

Inspect, clean, or change air filters once a month in your central air conditioner, furnace, and/or heat pump. Your contractor can show you how to do this. A dirty filter can increase energy costs and damage your equipment, leading to early failure (Maintenance Checklist).

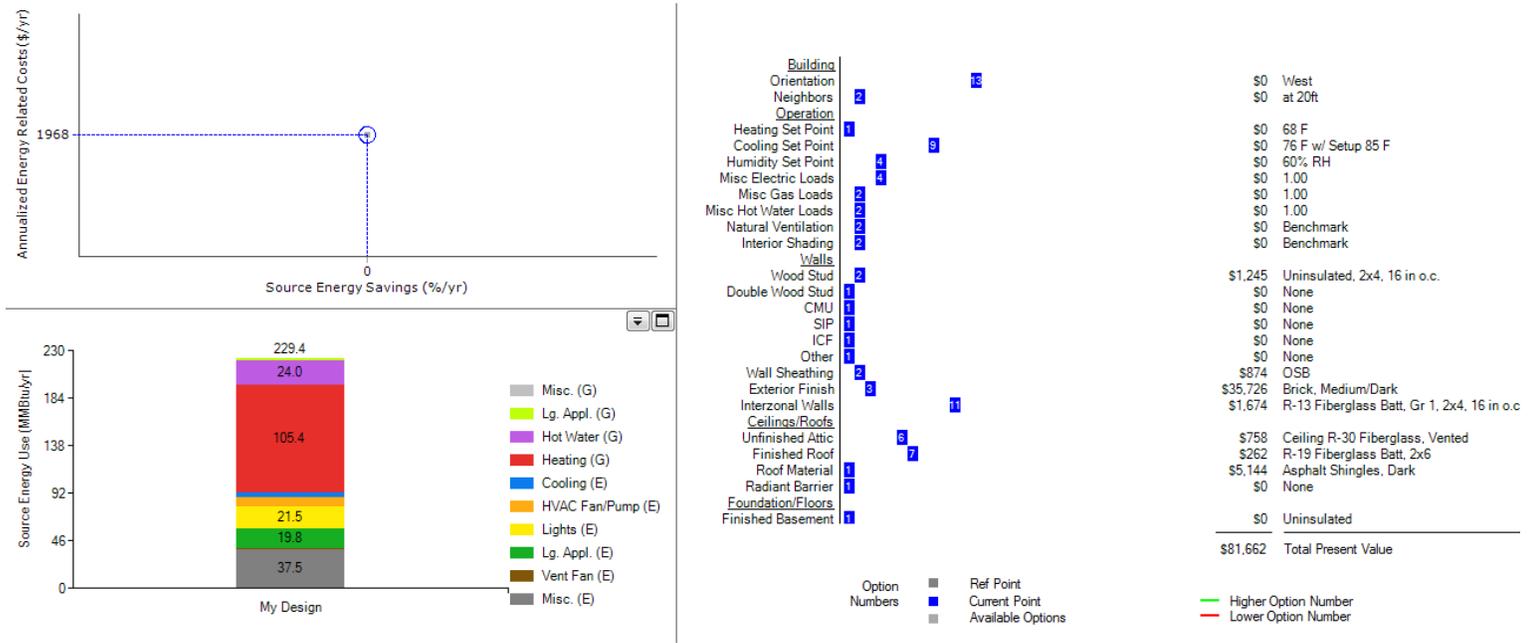
Standard Calculations and Assumptions

The average electric you used during a year was between 435-455 kWh. The electric and gas usage seems to be higher during the winter compared to summer, probably due to heating, especially since some of your windows may be drafty, and you probably have some heat loss.

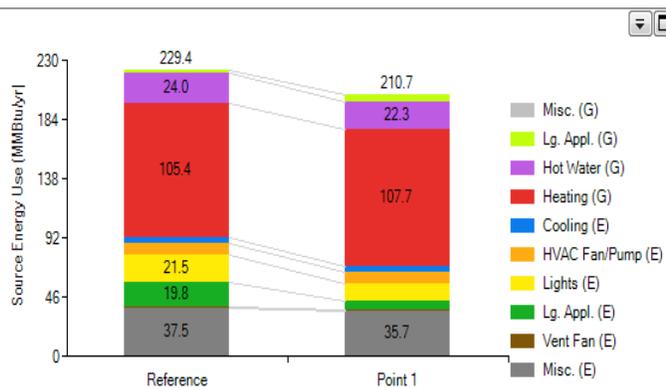
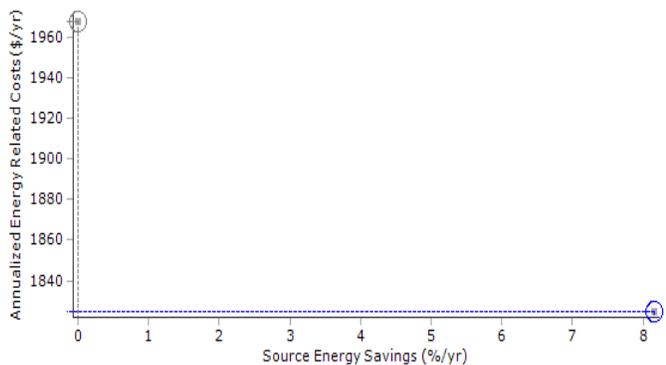


Audit Recommendations

My first recommendation is to change some of your appliances, ducts and lighting so you have more efficient energy star appliances, 7.5% leakage, R-6 ducts, and have 100% fluorescent, hardwired and plugin lighting. The cost to do this should only run a couple thousand dollars more than what you have now and can be quick to implement and less expensive. As you can see from the image below, the value of your existing house is about \$81,662.

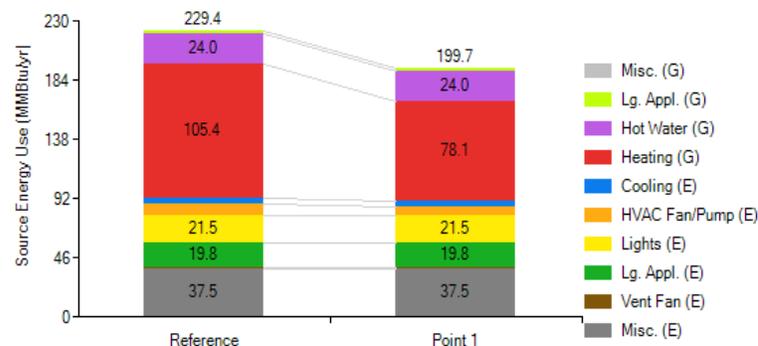
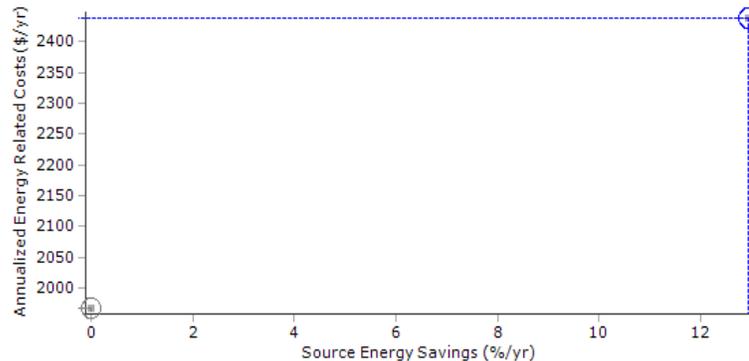


But, if you implement my first recommendation, you can see what the savings and value of your home becomes in the images below. You can save about 8%/yr on energy and have the cost be reasonably low. The value of your house will also increase.



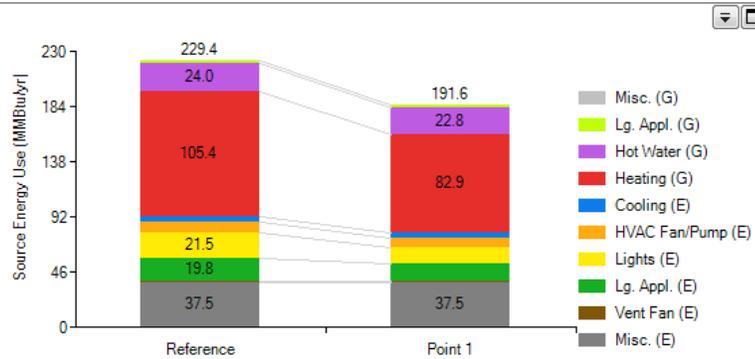
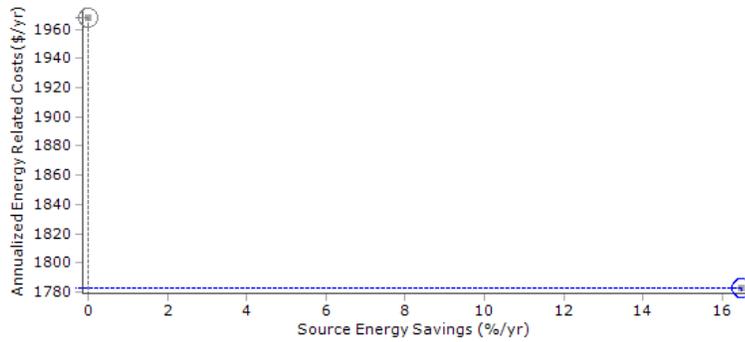
Partition Wall Mass	2	\$2,250	1/2 in. Drywall
Ceiling Mass	2	\$1,758	1/2 in. Drywall
<u>Windows & Doors</u>			
Window Areas	3	\$0	18.0% F20 B40 L20 R20
Windows	5	\$4,633	Double-Pane, Medium-Gain Low-E, Non-metal Fr.
Eaves	3	\$1,745	2 ft
Overhangs	1	\$0	None
<u>Airflow</u>			
Air Leakage	4	\$163	10 ACH50
Mechanical Ventilation	2	\$355	Exhaust
<u>Major Appliances</u>			
Refrigerator	12	\$1,457	18 cu ft., EF = 21.9, top freezer
Cooking Range	6	\$1,351	Gas, Conventional
Dishwasher	5	\$2,045	290 Annual kWh
Clothes Washer	5	\$1,155	EnergyStar
Clothes Dryer	5	\$1,859	Gas
<u>Lighting</u>			
Lighting	11	\$390	100% Fluorescent, Hardwired & Plugin
<u>Space Conditioning</u>			
Central Air Conditioner	2	\$3,439	SEER 13
Furnace	4	\$2,718	Gas, 80% AFUE
Boiler	1	\$0	None
Electric Baseboard	1	\$0	None
Air Source Heat Pump	1	\$0	None
Ground Source Heat Pump	1	\$0	None
Ducts	6	\$2,544	7.5% Leakage, R-6
Ceiling Fan	9	\$1,193	Premium Efficiency
		\$82,069	Total Present Value

My second recommendation is to change your windows to triple pane, low-gain low-e, insulated frame, argon fill, which can cost about 4 times more than the windows you have now, and to change air leakage from 10 ACH50 to 1 ACH50, which can also cost almost 4 times more than what you have now. As you can see in the images below, this recommendation does save you about 13%/yr on energy and increases the value of your home by quite a bit.



<u>Windows & Doors</u>			
Window Areas	3	\$0	18.0% F20 B40 L20 R20
Windows	5	\$20,270	Triple-Pane, Low-Gain Low-E, Insulated Frame, A
Eaves	3	\$1,745	2 ft
Overhangs	1	\$0	None
<u>Airflow</u>			
Air Leakage	4	\$594	1 ACH50
Mechanical Ventilation	2	\$355	Exhaust
<u>Major Appliances</u>			
Refrigerator	12	\$921	18 cu ft., EF = 15.9, top freezer
Cooking Range	6	\$1,351	Gas, Conventional
Dishwasher	4	\$1,874	318 Annual kWh
Clothes Washer	4	\$1,030	Standard
Clothes Dryer	4	\$1,413	Electric
<u>Lighting</u>			
Lighting	1	\$613	Benchmark
<u>Space Conditioning</u>			
Central Air Conditioner	2	\$2,902	SEER 13
Furnace	4	\$2,405	Gas, 80% AFUE
Boiler	1	\$0	None
Electric Baseboard	1	\$0	None
Air Source Heat Pump	1	\$0	None
Ground Source Heat Pump	1	\$0	None
Ducts	6	\$2,381	15% Leakage, R-6
Ceiling Fan	2	\$2,004	Benchmark
Dehumidifier	2	\$493	Autosized, Standalone
<u>Water Heating</u>			
Water Heater	6	\$1,921	Gas Standard
		\$96,699	Total Present Value

Some of the benefits to having triple pane windows are more energy savings, improved insulation, and added security. Triple pane windows can give you up to 50% savings over your single-pane windows and up to 20% savings on top of double pane (Sublousky, J., 2013). You get added security by it is harder for intruders to break through the extra layers of glass. Some of the negatives to triple pane windows are extra weight and extra cost. The extra glass from triple pane windows makes them heavier and puts more pressure on the frame of the window. Because of the added glass, triple pane windows can be 25-30% more than double pane (Sublousky, J., 2013). Because triple pane windows can be costly, my third recommendation if triple pane windows are too expensive is to find something in between the first two recommendations by changing your windows to double pane, low-gain low-e, insulated frame, argon fill, which only costs about 2 times the amount you have now, change air leakage from 10 ACH50 to 1 ACH50, change some of your appliances, such as your refrigerator and washer, to energy star and energy efficient appliances, change your ducts to 7.5% leakage, R-6 ducts so there is less leakage, and change lighting to have 100% fluorescent, hardwired and plugin. Doing these things as you can see from the images below will be more cost effective and energy effective and only costs a few thousand more to implement. This recommendation can save 16%/yr of energy and is at a reasonable cost to you.



Partition Wall Mass	2	\$2,250	1/2 in. Drywall
Ceiling Mass	2	\$1,758	1/2 in. Drywall
<u>Windows & Doors</u>			
Window Areas	3	\$0	18.0% F20 B40 L20 R20
Windows	5	\$7,020	Double-Pane, Low-Gain Low-E, Insulated Frame,
Eaves	3	\$1,745	2 ft
Overhangs	1	\$0	None
<u>Airflow</u>			
Air Leakage	4	\$594	1 ACH50
Mechanical Ventilation	2	\$355	Exhaust
<u>Major Appliances</u>			
Refrigerator	12	\$1,457	18 cu ft., EF = 21.9, top freezer
Cooking Range	6	\$1,351	Gas, Conventional
Dishwasher	4	\$1,874	318 Annual kWh
Clothes Washer	4	\$1,155	EnergyStar
Clothes Dryer	4	\$1,413	Electric
<u>Lighting</u>			
Lighting	1	\$390	100% Fluorescent, Hardwired & Plugin
<u>Space Conditioning</u>			
Central Air Conditioner	2	\$2,902	SEER 13
Furnace	4	\$2,405	Gas, 80% AFUE
Boiler	1	\$0	None
Electric Baseboard	1	\$0	None
Air Source Heat Pump	1	\$0	None
Ground Source Heat Pump	1	\$0	None
Ducts	6	\$2,544	7.5% Leakage, R-6
Ceiling Fan	2	\$2,004	Benchmark
Dehumidifier	2	\$494	Autosized, Standalone
		\$84,051	Total Present Value

Final Conclusion

Based on the recommendations, my alternative that I would recommend is the third recommendation because this choice has the most energy savings as shown in the images and is still at a reasonable cost to you, especially compared to the second recommendation with the triple pane windows that is the next best for energy savings, but at a much higher cost.

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