Energy: Home Energy Audit

Introduction

Energy Transfers and the First Law of Thermodynamics

In the 1800's, scientists found, empirically, that rules exist that determine how energy can be transferred. The first of these rules is called the First Law of Thermodynamics. This law is usually stated as, "Energy can neither be created nor destroyed; it can only be transferred from one form to another." This often leads to the re-titling of this law as the Conservation of Energy Principle since it says that energy must be conserved.

This statement of the First Law does not say anything about how energy can be transferred, though. It turns out that there are only two ways. This was discovered in 1850 by the English scientist James Joule, who found that heat and work are equivalent methods for changing the energy of an object. In his experimental work, Joule was able to show that he could increase the thermal energy of a pot of water by either placing it over a flame (adding heat), or by stirring it with a paddle (doing work). For this and other important work in this area, the SI unit of energy is called a joule ($1\ J = 1\ kg\ m^2/sec^2$). Using this, we can re-write the First Law mathematically as

$$\Delta E = W + Q$$

where ΔE is the change in the energy of an object, W is the work done on the object, and Q is the heat added to an object. In laymen's terms, this means that the only way to change the energy of an object is to exchange either work or heat with it.

Energy History

The discovery of the laws of thermodynamics was extremely important, as our need to understand energy is fueled by the overwhelming use of energy in human society. From the earliest days, humankind has recognized the need to use energy to condition the environment around it. Wood was needed to heat homes and to cook food. Beasts of burden were needed to plow fields and to provide transportation. When either of these commodities became scarce, hardship prevailed, and solutions were sought. In ancient Rome, for example, the lack of available firewood led to the passing of laws that made it illegal to build a house or structure that would block another person's home from getting sunlight, as this was the primary method of heating homes without fire.

In the 20th century, fossil fuels (oil in particular) reigned supreme as the energy of choice. Their ubiquitous nature created historically low prices for energy. This led to a substantial increase in the number of mechanized tools used by the average citizen. By the year 2000, the U.S. had a population of about 283 million people that were driving over 200 million passenger vehicles. Almost every home in America has a television, some type of range or stove, and a refrigerator. About 3/4 of all households have their own washer, dryer, and air conditioner. Of course, this cheap price does not come without some political and economic consequences. Energy, and oil in particular, have played a very important role in the economy and

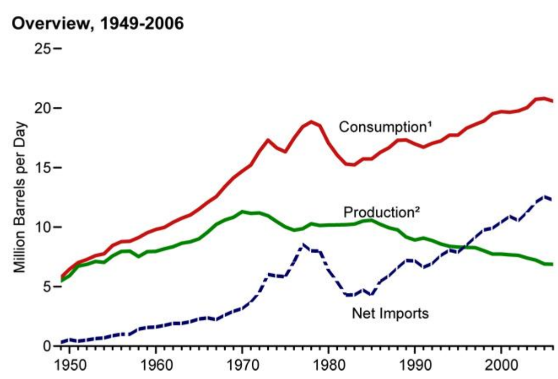

Fig. 1: U.S. Oil Consumption (Source: DOE)

politics throughout the last 150 years, affecting everything from the entry of U.S. into World War II to the rampant inflation of the 1970's to the current de-stabilized situation in the Middle East.

Energy Use in the U.S.

This modern dependence on many appliances of convenience requires a lot of energy. Our current energy per capita use is over 330 million BTU's of energy. Put another way, this means that the average U.S. citizen would be responsible for using almost 60 barrels of crude oil each year, if all of the energy used in America came from oil. The only other country in the Western World that was even close to this is Canada, which has almost the same amount of usage. Most of the Western world uses 200 million BTU's of energy or less. Although we make up only about 5% of the world's population, we account for almost 25% of all of its energy consumption. In comparison, many Third World countries such as Ethiopia use less than 1 million BTU's per person.

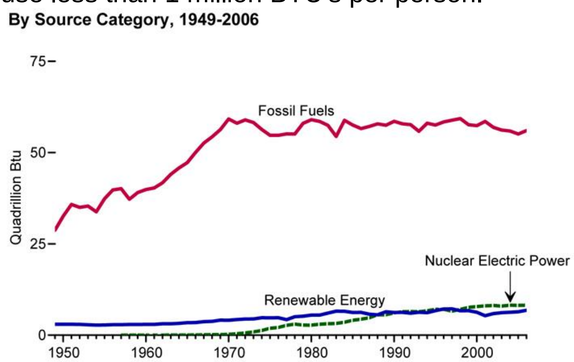

Fig. 2: U.S. Energy Production (DOE)

The majority of this energy (85%) is supplied by fossil fuels. Crude oil accounts for the largest share of this (40%), followed closely by coal (23%) and natural gas (22%). The remaining energy comes mostly from nuclear (8%) and renewable sources like hydroelectric, solar, and wind (7%). Contrary to common belief, most of this energy is produced domestically. The only energy source that we are forced to import is crude oil, of which we can currently supply only about 45% of our need.

Of the energy used in the U.S., about 38% of it is used for industrial processes (mining, milling, etc.), 36% of it is used to power homes and offices, and 28% of it is used for transportation. While most of us cannot directly affect the amount of energy used for industrial processes, we can do something about our residential and transportation energy use. The figures above mean that about 101 million Btu's are used each year just to run our households (this does not include the energy that was lost in producing and transporting this energy, which accounts for an additional 71 million Btu's). The majority of this energy use is to heat and cool our homes (55%). In this week's lab, we are going to begin to study ways to reduce our home energy usage, primarily through reducing our demand for heating and cooling.

Measuring your home

We are going to begin our analysis of our dwelling in two parts. In this week's part, we are going to prepare for the home energy analysis that will be performed in the coming weeks by measuring the surface areas of our dwellings that are exposed to outside temperatures. While doing this, we will note what materials were used in the construction of our dwelling. In next week's part, we are going to estimate the amount of energy that is being lost in our homes or apartments due to conduction and convection. This type of heat transfer depends upon the type of materials used for construction, the amount of surface area through which heat is transferred, and the temperature difference across the material. The type of material can drastically change the amount of heat that is conducted from a hot to a cold region. Plywood, by itself, provides little resistance to the flow of heat; plywood, combined with fiberglass and polystyrene insulation, can provide a significant barrier to conduction and allow large temperature differences to be maintained between hot and cold regions.

While we are making these measurements of the exterior surfaces of our home, we will also be gathering some basic information about energy-using devices in our home, such as the refrigeration, cooking, and water heating systems. These systems are responsible for most of the energy used in the home outside of the heating and air-conditioning systems. These are also systems for which there can be a wide range of energy efficiency between various makes and models.

Instructions – Part A, Week 1

1. Prepare a drawing of your dwelling. This does not need to be an intricate blueprint of your dwelling (although it helps if you already have one), but a simple illustration of it that will allow for all external surface measurements to be shown. The Activity Sheet has a grid on which you can sketch your dwelling. Indicate north on the illustration.
2. On your drawing, please signify the measurements of all exterior, heat-dissipating surfaces. These will be surfaces that lead from an air-conditioned and heated room to either the exterior of the house or to rooms (ex garage) that are not heated or air-conditioned. **NOTE: These measurements do not need to be made from the outside of the home; measurements made from the inside of the house will be sufficient)**
3. While you are measuring the exterior components of your home, note the materials from which they are constructed. For instance, is your exterior door constructed of 1 1/2 inch solid wood, or is it 1 3/4 steel with foam insulation? Enter this information on your Data Sheet (Exterior Surface Type section) as to type of material of each exterior surface (Interior surfaces are irrelevant for calculating heat transfer since internal heat transfers do not affect the amount of energy lost or gained to your home). Some homes will have more than one surface type for each exterior surface. For instance, a house might have single and double paned windows. If so, make sure that both types of surfaces are entered onto the sheet.

Instructions – Part B, Week 2

1. Using the measurements from your drawing last week, calculate the area of each exterior surface in your home and enter the data on the Data Sheet provided. Round off all dimensions to the square foot and enter the data into the appropriate slot for each surface type. If you have more than one surface type for each component, remember to the different areas for each type (ex. if you have 10 square feet of single paned windows and 20 square feet of double paned windows, be sure to put the appropriate amount in each slot). If you are unsure of how to calculate areas of external surfaces, look at the example audit.
2. For each surface type, check the list of surface types and fill in the value for the appropriate R factor (Ex. single pane window, R: .9).
3. From your drawing, calculate the square footage of the livable space and write this value in the appropriate slot on your Data Sheet. If you have not done so already, measure/estimate the average height of the ceilings in that living space, and place the value in the slot below this.
4. Check the accuracy of thermostats on your heating and air conditioning unit. While you might think that you have it set at 70 degrees, it might actually be maintaining a temperature of 72. This can be checking by placing an accurate thermometer near the thermostat and noting any differences between the readings. Noting any differences, record the temperature settings for both the air conditioner and heater during the year.
5. The final audit will require certain information about the appliances in your home. You will need to know what type of heating and cooling system your home has, as well as the types of major appliances. For heaters and air conditioners, describe the energy source (electrical, natural gas, wood, etc.) and tell whether the system is centralized (ductwork takes the air to all parts of the home) or not. For the other appliances, check the line next to the type if you have it. For electrical stoves and dryers, we are also going to need to know the wattage of

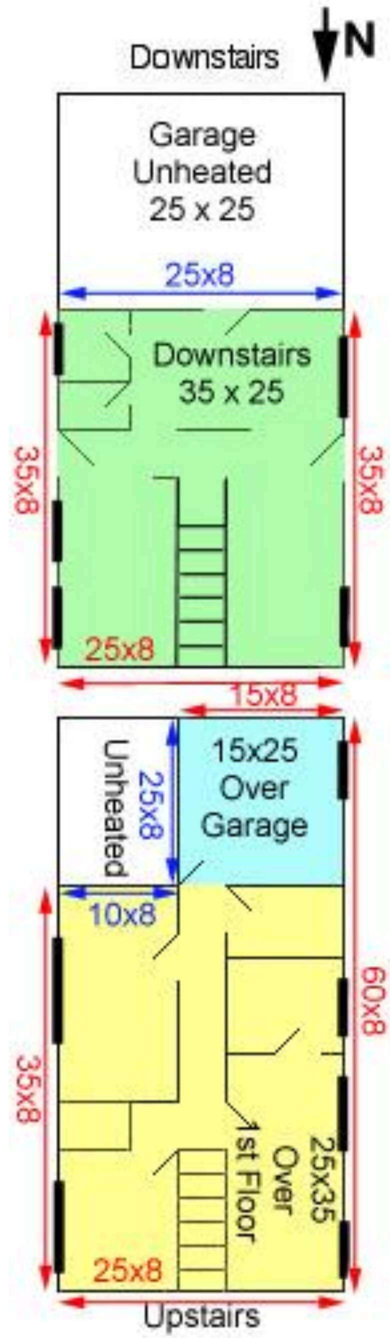

Fig. 3: Sample house drawing

the appliances. If you cannot find this information on the inside door of the appliance, please note this on your data sheet.

6. From your utility company(ies), find out the cost per unit energy for your energy source(s). For some companies, this information will be printed on their bill (Ex. $.75/therm on a natural gas bill or $.08/kWhr on an electric bill). For other companies, this information can be extracted from the bill by dividing the total cost of the energy by the amount of energy that was used. If this information is not on your bill, or if you do not have a bill to check, call the companies that supply you with energy and ask the rate that they are billing you.

We are now ready to use the calculator to estimate the energy usage in your home. Before we begin, we must state a few simple facts about the calculator. The first of these is that the calculator will not include the cost of running all of the smaller appliances in the home. The reason for this is that the list of appliances that we would have to include would make the calculator very unwieldy to use, as you would either have to scroll down a very lengthy list of items or to click through many different web pages. If you wish to figure out how much these appliances will cost you to run them, simply multiply the power of the appliance (in kilowatts) times the number of hours that you use it during the year times the cost of electricity.

The second thing that we must state is that this estimate is only as good as the information that is entered into the computer. If you enter incorrect data, e.g. if you enter 1 air exchange per hour when the actual number is closer to 0.5, you might find that the estimated cost of energy for your home is radically different than what you actually pay. Lastly, we need to point out that the calculator that we will be using has several assumptions built into it. As we go through the instructions below, these assumptions will be pointed out. If these assumptions are not valid for your home, the estimates of your cost can be far from reality. In analyzing your data, you will need to keep these assumptions in mind in order to come to valid conclusions about the energy usage in your home

With this in mind, let us proceed to the calculator by clicking on **this link** **AFTER YOU HAVE READ THE INSTRUCTIONS**.

1. The calculator comes in two parts, both of which are on the same page. You will need to finish the first section before proceeding to the second section. The first section concerns the measurements of your home that you took several weeks ago. You will notice that this section is laid out similar to the form that you filled out for each room of your home. There are two ways for you to enter the data for this section. One way would be to enter the data for each room of your home as it is listed on your worksheet(s). After typing this in, press the Calculate button that is on the left side of the screen. After the program makes the calculation, click the Next Set of Surfaces button to clear the room data. Enter the data for the next room, and proceed as above until all rooms are finished. The second way to fill in the data can only be used if the surfaces in your home are all the same (ex. all windows are double pane, all walls are R-factor 19 wall, all ceilings are R-factor 30, etc.). If this is the case, then you can add up all of the area for each component and enter it as if there were only one room.
2. After you finish entering the Conduction data, scroll down the page to the section entitled "Other Household Data".
3. From your drawings, you should be able to calculate the total area of all south-facing windows in your home that are not shaded from the outside. The reason why you need to know this data is that your south-facing windows are a source of solar energy. During the summer, each square foot of south-facing window will allow about 37 Btu/hr of solar energy into the house, unless it is blocked from entering the house outside of the window (curtains or shades on the inside of the window do not count as shade since they allow the energy into the home before blocking it). In the winter, this value is about 27 Btu/hr. Enter the area in the topmost text area of the section.
4. In the second slot, enter the total area of all east- and west-facing windows. While these windows do not allow sunshine into the house the entire day, they do allow solar energy in for half of the day. During the summer, this can be significant since the Sun will be further north in the sky throughout the day.

5. The next slot asks you for the square footage of the cooled and heated floor space in your home. You should be able to calculate this from your drawing.
6. The next slot asks for the average height of the ceilings in your home. In conjunction with the square footage of the floors of your home, these two numbers give us an estimate of the volume of air space in the home. This is the amount of air that must be heated and cooled as air is being exchanged with the outside environment.
7. The next two slots ask for the thermostat settings for both winter and summer. These temperatures will determine the rate at which heat is exchanged with the outside, and thus, how much cooling and heating are necessary. Two assumptions go into this calculation. The first one is that the thermostat is not being switched from this temperature setting, i.e. the thermostat is not a programmable thermostat. If you have such a thermostat, you will need to enter an average setting of your thermostat that will take into account the variability of the temperature in your home. For instance, if you set your thermostat in summer at 78 during the day and 72 at night, then you will probably want to enter 74 as your average temperature (while 75 might be the actual average, this does not take into account that the variation in temperature during the day actually lowers the average temperature difference between inside and outside). The second assumption in this calculation is that we are experiencing a normal year in outside temperatures.
8. The next slot asks you to enter the number of air exchanges per hour in your home. Refer to the first page of this module for help in estimating this number.
9. The next slot asks you to enter the number of people in the home. This number is needed, since human bodies produce heat. In the winter, this decreases the amount of heating that you will need; in the summer, it will increase the amount of cooling that you need.
10. The next slot asks you what type of ductwork you have for your heating system. If you have central heat, then you will have some type of ductwork to bring the heated air to each room. If this ductwork is insulated, then you need to enter 1 in the slot; if it is not insulated, then you need to enter 2. If you use a wood stove or a portable kerosene heater in your home, you have no ductwork, and should enter 0 in the slot.
11. The next slot asks you what type of heater that you have. This is important, since it will determine what type of fuel that you use and how efficient each type of heater is. We are assuming that a natural gas and propane heaters are 80% efficient, a resistive electric heater is 100% efficient, a heat pump is 250% efficient (remember our discussion about heat pumps in week three of this module), and a wood stove is 60% efficient. If your true efficiencies differ from this, it will cause some error in the estimates. In order to select the appropriate stove, please enter the corresponding number in the slot
12. The next slot asks for the type of air conditioner that you have. We have assumed that all air conditioners have a seasonal performance factor of 2.5. If you have no air conditioner, enter a 0 in the slot; for window units, enter 1; for a central air conditioning system, enter 2.
13. The next several slots deal with some of the major appliances in your home. Enter the appropriate data in each slot, including the number of hours each appliance is used in a typical week. We have assumed that all refrigerators and hot water heaters are always operating.
14. The last bit of data that you need to enter is the price of each fuel that you use. This data should be available from the energy supplier that you use. If it is not, we have provided an estimated average of current costs.

After completing all of this data, press the **Calculate Summary** button at the bottom of the page. The program should return the cost of energy in your home for the year. If you find that you wish to change any of the Other Household data (the second section), you may do so without having to go back and enter the Conduction data again. Merely change the data that you want, and then press the **Calculate Summary** button again. It will recalculate your costs with the new changes. If you wish to change something about the Conduction data, you will need to press the **New Energy Analysis** button, which will clear the entire calculator and allow you to begin over again.

Example

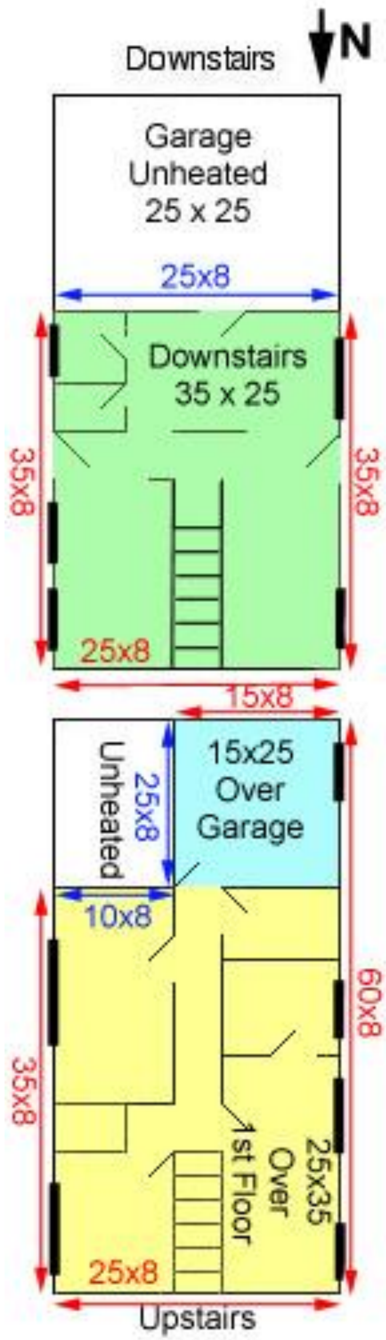

Fig. 4: Sample floor plan used in example

The floor plan at the left is of a wood-sided house built upon a cement slab. It is two stories tall with insulated walls and twelve inches of blown fiberglass insulation in the attic. The house is 5 years old, and has been well maintained. The garage, while sealed with doors, is not heated or cooled. The main living space occupies a 25'x35' space both upstairs and downstairs (yellow and green areas), with an additional 15'x25' room (blue area) on the second floor that is over the garage. Windows are as marked on the floor plan and are all 1/4" double pane. The three exterior doors are standard 3'x7' insulated-core steel doors.

The Data Sheet for this house looks like the following:

Type of structure: _X_ House ______ Apartment/Duplex ______Mobile Home
Number of stories _2__

Exterior Surface Types

	First Type	Second Type (if needed)
Windows	1/4" double paned	
Walls	Wood with 3 1/2" fiberglass and 1" foam	Sheetrock with 3 1/2" fiberglass
Doors	1 3/4" Pella	
Roof/Ceiling	12" fiberglass (blown)	
Ground Floor	Concrete slab	6" fiberglass over closed unheated space

Exterior Surface Types	Area	R-factor	Area	R-Factor
Windows	210	1.7		
Walls	1588	20	459	12
Doors	63	13		
Roof/Ceiling	1250	43		
Ground Floor	875	11	375	43

For instructions on how to calculate the areas in the above table, click here.

Total area of heated and air conditioned space: _2125__ sq. ft.
Average height of ceilings: _8__ ft.
Average indoor winter temperature (^{o}F): _69____
Average indoor summer temperature (^{o}F): __74____
Number of air exchanges per hour: __1___

Appliances

Heater Type: Central Natural Gas with insulated ducts
Air Conditioning Type: __Central Electric with insulated ducts _
Refrigerator/Freezer Combo: _1__
Gas Hot Water Heaters: _1_
Gas Stove/Oven: _1_
Electric Clothes Dryer: _1_ If yes: _2000__ Watts

R-Factors for Common Materials

After you have finished making the drawing of your dwelling with the measurements of the exterior surfaces, it is time to determine what is the R-factor of all of the exterior surfaces. The R-factor of a surface determines how quickly heat is conducted across it. The values below are some of the more common R-factors for surfaces found on homes in the U.S. **NOTE:** If your exterior surface leads into an enclosed area that is sealed, but is not heated or air-conditioned (ex. a door that leads to a closed garage), then multiply the R-factors below by 1.5 in order to get a better estimate of the factor. If the enclosed area happens to be earth-sheltered (ex. a basement that is not heat or cooled), then multiply the R-factors by 2.0.

Exterior Doors (Excluding sliding glass doors)
Calculate glass area of door as window

Wood Door	Factor
1 1/4" no storm door	2.4
1 1/4" with 1" storm door	3.8
1 1/2" no storm door	2.7
1 1/2" with 1" storm door	4.3
1 2/3" solid core door	3.1
Steel with Foam Core Door	
1 3/4" Pella	13
1 3/4" Therma-Tru	16

Roof/Ceiling

Material	Factor
No insulation	3.3
3 1/2" fiberglass	13
6" fiberglass	20
6" cellulose	23
12" fiberglass	43
12" cellulose	46
14" cellulose	54

Exterior Walls with Siding

Concrete block (8")	Factor
(a.) Concrete block (8")	2.0
with Vermiculite insulated cores	13
with foam insulated cores	20
with 4" on un-insulated stud wall	4.3
with 4" insulated stud wall	14
with 1" air space and 1/2" drywall	2.7
Brick (4")	
with 4" un-insulated stud wall	4
with 4" insulated stud wall	14
Wooden Logs	
Logs (6")	8.3
Logs (8")	11
Wooden Frame	
Un-insulated with 2" x 4" construction	4.6
with 1 1/2" fiberglass	9

Floor

Over unheated basement or crawl space vented to outside	Factor
Un-insulated floor	4.3
6" fiberglass floor insulation	25
Over sealed, unheated, completely underground basement	
Un-insulated floor	8
with 1" foam on basement walls	19
with 3 1/2 fiberglass on basement walls	20
Insulated floor, 6" fiberglass	43
Concrete Slab	
No insulation	11
1" foam perimeter insulation	46
2" foam perimeter insulation	65

with 3 1/2" fiberglass; studs 16" o.c.	12
with 3 1/2" fiberglass and 1" foam	20
with 6" fiberglass; studs 24" o.c.	19
with 6" fiberglass and 1" foam	26
with 6" cellulose	22
with 6" cellulose and 1" foam	28

Windows and Sliding Glass Doors:

Glass	Factor	Low Emissivity	Drapes	Quilts
Single pane	0.9	1.1	1.4	3.2
Single w/storm window	2.0		2.5	4.2
Double pane, 1/4" air space	1.7		2.2	4.0
1/2" air space	2.0	2.99	2.5	4.3
Triple pane, 1/4" air space	2.6		3.0	4.8
Triple pane, 1/2" air space	3.2	3.7	3.7	5.5

Convection

The average household spends over $1,300 a year for energy to run the many devices found in the home[1]. In this week's lab, we are going to investigate ways to save both energy and money. In order to do this, we are going to have to use the measurements of our dwellings that we made in the last lab.

Different materials affect the amount of heat flow by conduction. This is important, since heat conduction is one of the primary ways that energy is lost in a home. While measuring our dwellings, we took not of what type of material was used on the exterior surface in order to see how great heat conduction would be through that surface. Another method by which heat is flowing into or out of our homes is convection. Convection is heat transport by movement and mixing. When we open the doors to our homes, hot and cold air are allowed to mix, and heat is convected. Even when doors or windows are not open, there is convection occurring through any cracks or breaks in our windows, walls, doors, ceilings, and floors. We often notice this convection occurring on very cold, windy days. You will often find a blast of cold air hitting you when you walk by electrical outlets or windows on such days, a sign that your house is not airtight.

Of course, as air from the outside is coming into your home, the air inside of your home is going outside. Over time, the total volume of air in your home will be completely replaced with air from the outside. While this is good from the standpoint that stale, possibly toxic air is leaving your home, it is bad from an energy standpoint since your heating/cooling system will have to come on to bring this air temperature back to the prescribed setting. In a new, well-built home, the number of openings in your home allows this air exchange to occur over a period of about 2 hours. In older homes that have developed more cracks, this amount of time can be much shorter. For instance, in very old, poorly maintained homes, it might take as little as 15 minutes for all of the air in your home to be replaced by air from the outside. The number of air exchanges per hour, therefore, is a measure how much energy you will need to use in order to counter the effects of heat transfer via convection.

The proper way to measure the number of air exchanges per hour in your home is somewhat involved. It requires using air flow meter readings from various locations in your home. Since very few people have the necessary equipment to measure it exactly, we have developed a set of guidelines for estimating this factor. The table below gives you some idea as to the value for your home. You may need to interpolate between the values below to get the correct estimate for your home. For instance, if you have an average, insulated home that has been caulked and weather stripped in the last 4-5 years, you should probably select 1.0 as your value. However, if it has been about 8-10 years since you caulked or weatherstripped, you might want to choose something between 1.0 and 2.0 as the value.

Type of home	Air exchanges per hour
Old, un-insulated, weatherstripping not maintained	4.0
Old, un-insulated, weatherstripping maintained	2.0
Avg. insulated house, well maintained	1.0
New, well insulated house	0.5
New, super-insulated (12" walls)	0.2

Home Audit Tips

1. Unless you live in a very unusual structure, the walls of your dwelling should be 3 1/2 inch studded walls. The biggest question you should have is whether your walls are insulated. If you do not know, there are a few ways to find out. If you dwelling was built since 1980, the odds are that it is insulated with fiberglass insulation. If your home was built before this, then the answer is not so easy. You could determine if there is insulation in the walls by cutting or smashing a hole in the wall to see. However, this is not recommended. There are probably holes in your exterior wall already. Remove the faceplate from either an outlet or a light switch that are on an exterior wall. Be very careful NOT to stick anything into the socket or switch. Once the plate is off (make sure that it does not rip the paint or paper off of the wall), you should be able to see around the side of the outlet box to see if there is any insulation in the wall.
2. If the ceilings in your home are horizontal, then the area of the ceiling is the same as the area of the floor. Therefore, there is no need to get on a ladder to measure the area of your ceiling. If you have vaulted ceilings, the task of measuring the area of your ceiling is slightly more difficult. You can try to measure the distance along the vault if your tape measurer is rigid enough to allow this. If you cannot measure the distance this way, you will need to use a little geometry to aid you. Measure the height (vertical distance) of the ceiling at its highest and lowest points. Then measure the horizontal distance from the highest to the lowest points. You can now use the Pythagorean Theorem to calculate the distance. Square the difference in the vertical distance between the highest and lowest points. Square the horizontal distance between the two points. Now, add the squares together and take the square root of the sum. This will give you the distance along the vault.
3. If your ceiling is neither horizontal nor vaulted (ex. bi-level or tri-level), then you will need to measure or estimate all horizontal and vertical surface areas and sum them together.
4. The wattage information for your electric stove, oven, or dryer should be found on tags somewhere on the device. On these devices, this is usually on a metal tag either on the side of the door or in the door opening. If it is not, then it is probably on the backside of the device. If it possible to easily get to the backside of the device, please do so. If it is not easy, then write "Could not find" on your sheet. When we get to the calculator section of the audit in two weeks, you should just use the average values that the calculator gives you as a default.

Name: **Activity Sheet Part A**

Home Drawing: In the chart below, sketch out your home with measurements of walls, floors, doors, windows, and ceilings. Denote North on the chart.

<u>Exterior Surface Types</u>

	First Type	Second Type (if needed)	Third Type (if needed)
Windows:	______________	______________	______________
Walls:	______________	______________	______________
Doors:	______________	______________	______________
Roof/Ceiling:	______________	______________	______________
Ground Floor:	______________	______________	______________

Name: **Activity Sheet Part B**

Structure Data

Type of structure: _____ House ______ Apartment/Duplex ______Mobile Home
Number of stories _____

Ext. Surface Type	Area	R-Factor	Area	R-Factor	Area	R-Factor
Windows						
Doors						
Walls						
Roof/Ceiling						
Ground Floor						

Total area of heated and air conditioned space: __________ sq. ft.
Average height of ceilings: ___________ ft.
Average indoor winter temperature (^oF): ________
Average indoor summer temperature (^oF): ________
Number of air exchanges per hour: ________

Appliances

Heater Type: _________________________ Air Conditioning Type: ___________________
Refrigerators:____ Freezers:____ Refrigerator/Freezer Combo:_____
Electric Hot Water Heaters:____ Gas Hot Water Heaters:____
Electric Stove/Oven:____ If yes:______ Watts Gas Stove/Oven:____
Electric Clothes Dryer:____ If yes:______ Watts Gas Clothes Dryer:____

Energy Cost

Energy Source	Cost
Electricity	$___/kwh
Natural Gas	$___/therm
LP gas	$___/gal
Wood (cord = 128 ft^3)	$___/cord

Total Summer Heat Gains:_______MBTU Total Winter Heat Losses:______MBTU

Electric Costs: $________/year Gas Costs:$______/year
Propane Costs: $________/year Wood Costs: $______/year

How close is this estimate to your actual costs?