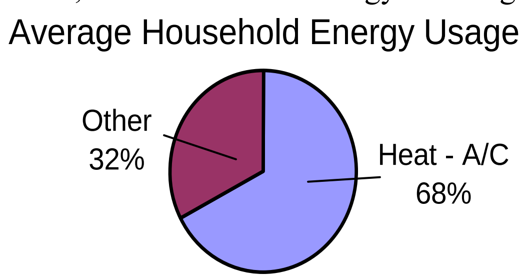
MANAGING YOUR HOME'S ENERGY USAGE

Managing energy usage in your home can appear to be a daunting task. But, by breaking this down into smaller parts, a typical homeowner can understand and control the energy they use. For a typical house, here's where the energy dollars go:



Since over 2/3 of your typical energy budget goes to heating and cooling, this is where we can focus more of our attention. But, we won't ignore the "other" either.

HOMEWORK SECTION

"To know where we need to go, we first have to know where we have been..."

Since heating/cooling costs are significant in this climate, let's look at them first. The Energy Information Administration (a part of the U.S. Department of Energy) has projected regional heating costs for 2011-2012. These are based upon the following:

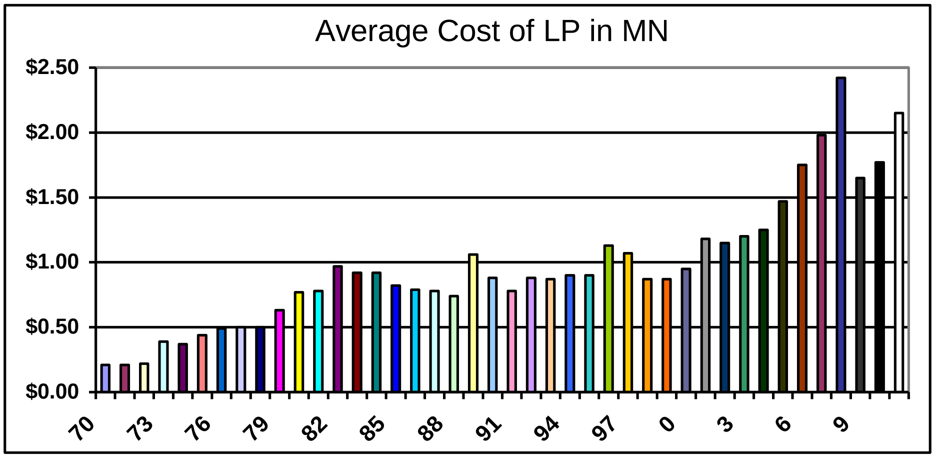
- An average winter, with some areas colder but other areas warmer than previous years, resulting in similar heating fuel demand compared to last year
- Low growth in the global economy, which may result in a short-term decrease in demand for fossil fuel
- Some fluctuations in fuel prices tied to unstable local and global financial markets
- Limited disruptions to supply caused by severe weather or political turmoil.
- Increased new production of natural gas because of shale gas development

With these factors in mind, here are their projections for regional heating prices the winter of 2011-2012:

Natural Gas: $0.80/therm (similar to previous year)

Rates in the Brainerd area averaged above $1.00/therm the last several years (this includes fuel adjustments, new service area rider, and fixed charges). There has been a recent increase in domestic NG production due to new extraction technology which has driven down prices. But, this may also cause serious environmental problems, forcing a dramatic drop in future production with costs rising rapidly.

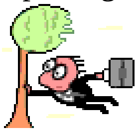
Propane (LP): $2.15/gal (about 16% more than last winter)
So far this year, local pre-buy prices have ranged from as low as $1.99/gal to as high as $2.25/gal. We anticipate costs this winter will average $2.15/gal. For most customers, monthly tank leases have become a significant cost in recent years.



Fuel Oil: $3.10/gal (a 9% increase since last winter)
The price of heating oil is tied closely to the pump price of diesel fuel. Over the last few years, this has been an extremely volatile market with prices peaking well over $4/gal. Colder weather, especially on the East Coast, can quickly drive these prices up.

Electricity: 6.9¢/kwh local (may have Power Cost Adjustments and Controlled Rates)
The majority of our electricity comes from domestic coal, which has had stable costs for a number of years. Increases in demand, coupled with the need to upgrade the related infrastructure, may result in incremental cost increases.
A consumer can use controllable electric rates for selected loads, such as electric heating. These rates can be up to 60% less than standard costs, resulting in impressive savings.

The average consumer doesn't have any real control over the cost of energy. Managing the cost of heating your home boils down to understanding and controlling *how* it uses energy. This knowledge is also useful in making good decisions on upgrading your heating system or even replacing it with something that may use other energy sources.

CLIMATE TRENDS 

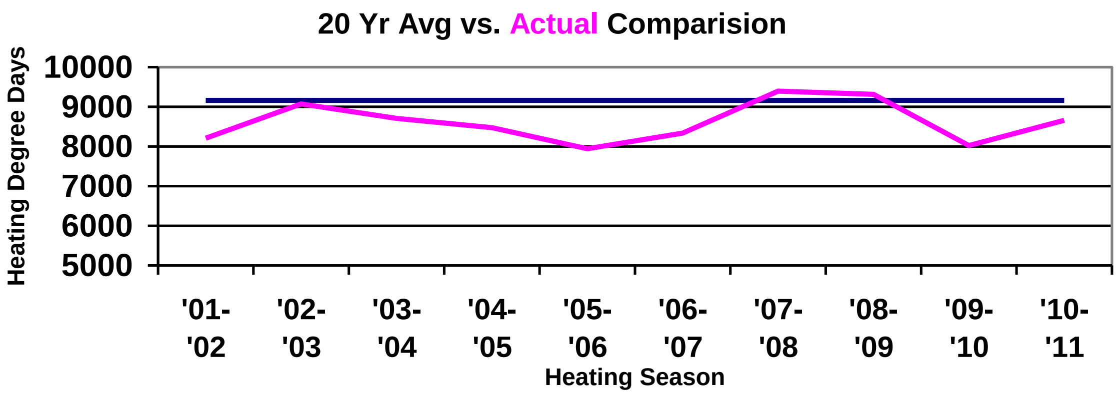
In this climate, heating is more significant than cooling so most of our discussion is focused on heating costs. Let's look at our local climate and how it affects your heating bills.

One means of tracking local climate trends is by "Heating Degree Days". It is calculated by subtracting the *average* temperature for the day from 65F (the temperature at which an ordinary house needs supplemental heat). As an example, assume today's average temperature is 30F:

65F (base temp)
- 30F (actual average temp)
x 1 day
= 35 Heating Degree Days

For a measure of severity for a given heating season (typically October through May), you would add-up all its heating degree days. Here's how this looks for Brainerd:

Heating Season	Total Heating Degree Days	%Difference
'01 – '02	8209	
'02 – '03	9071	+10%
'03 – '04	8713	-4%
'04 – '05	8479	-3%
'05 – '06	7943	-6%
'06 – '07	8335	+5%
'07 – '08	9392	+13%
'08 – '09	9317	-1%
'09 – '10	8027	-14%
'10 – '11	9122	+14%
10 yr average	8661	
20 yr Average	**9163**	**+5%**



Here's an example how to use these numbers; if you noted that the total energy to heat your home last winter ('10-'11) was about 14% more than the previous year, this would be proportional to the increase in heating degree days from '09-'10 (8027 vs 9122). The last 10 years are running an average of 5% warmer than the 20 year figure; we are uncertain if that is a short or long term trend.

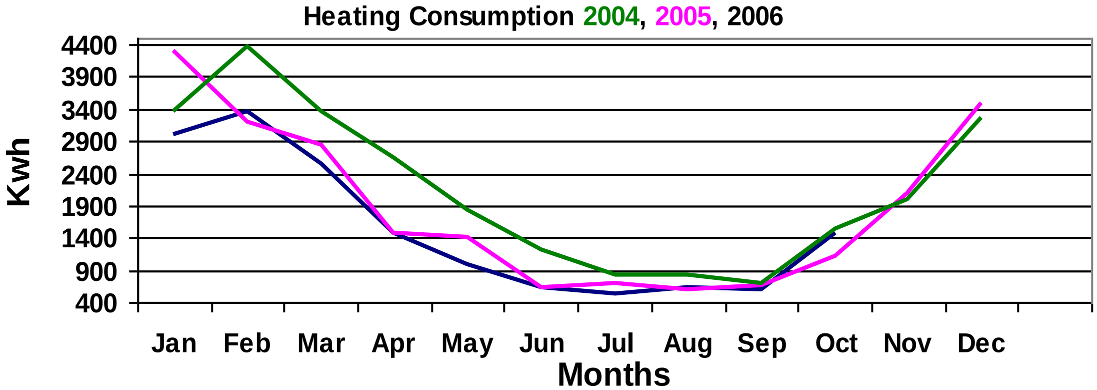
Cooling Degree Days also exist. These are used to compare air conditioning energy consumption over several seasons. In this climate, air conditioning costs have not been significant, so historical data is not as readily available as for heating. If the long-term climate does change, cooling may become more important in the future.

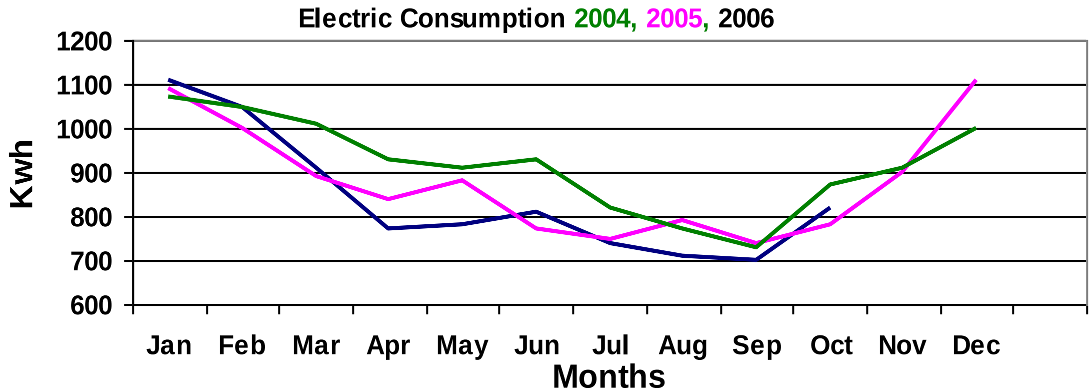
YOUR OWN HISTORY

To put some real numbers to these trends, you will need your own historical data. Gather your energy bills for at least several years; include both electricity and heating fuels. To eliminate skewing these by the changes in energy prices, convert to a common unit of energy, such as BTU's or Kwh's (3.412 BTU/watt). As you lay these out, also add notes on factors that may affect energy consumption. Examples would be:

Summer '04, oldest son moved away to college (*smaller household = less energy*)
Summer '05, purchased new refrigerator and replaced air conditioner (*should reduce electric bill*)
Fall '06, new windows in kitchen (*may reduce air leakage and heat loss*)

ENERGY USAGE OF AN ALL-ELECTRIC HOME:





There is a noticeable drop in both heating and electric usage the year the oldest son moved away to college, so the number of people in a family does affect consumption. The Winter of '06 was slightly colder, so the new windows really helped to cut heat loss.

GOAL SETTING

Once you have a picture of what your energy usage has been, you can make more intelligent decisions on where your energy goes and what to do about it. You can also start putting real numbers to costs vs. benefits for anticipated upgrades. Each house is unique, but here are some general guidelines on costs/benefits for a typical home:

Upgrade Cost	Expected Energy Savings% (Benefit)
None (Change Habits, Adjustments)	Up to 5%
Low (Furnace Filter, New Lights)	Up to 10%
Medium (Weatherstripping, Set-Back 'Stat)	Up to 15%
High (Insulation, Windows, Furnace)	Up to 30%

Here are 2 examples on how to use these numbers:

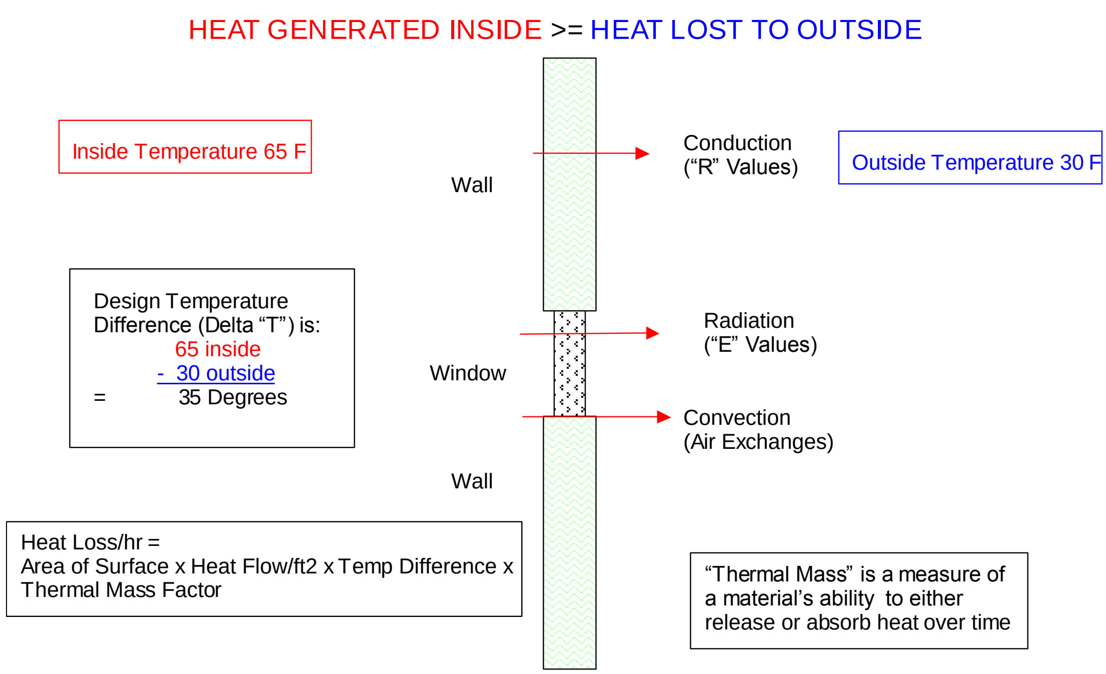
-At today's rates, it may cost $1,000/year to heat your home. You are considering replacing the drafty windows for a cost of $3,000. Generally speaking, replacement windows may save you up to 30% of your heating costs, $1,000 x 30% = $300 annual savings. $3,000 installed cost / $300 annual savings = 10 year payback. This may be a questionable investment based on simple payback calculations.

-Rather than replacing the windows, you decide to spend $50 on weather stripping for them. This could save you up to 15% on your energy costs. $1,000 x 15% = $150 annual savings. $50 installed cost / $150 annual savings = 1/3 year payback. With everything else being equal, this may be a better investment.

Please note that there might be reasons to replace the drafty windows in addition to energy savings. Maybe they leak water or don't lock and are also a security problem and are just plain ugly. These costs vs. benefits are generalized; each house may be different.

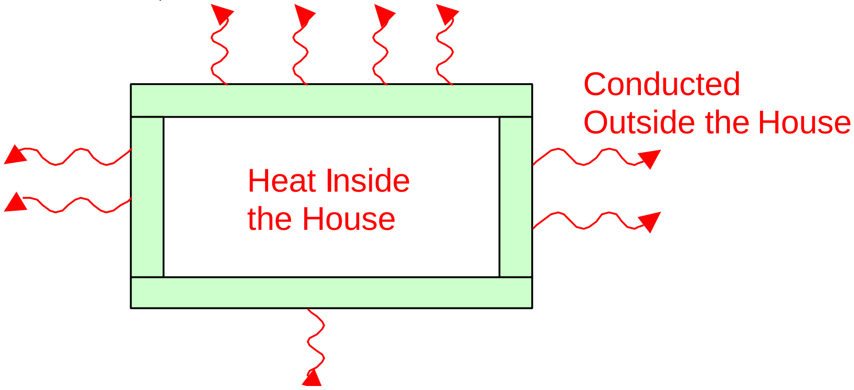
WHERE DOES THE HEAT GO?

The amount of heat required to keep your house comfortable is tied to the difference between the inside and the outside temperatures, and how the structure of your house resists the movement of this heat. Here's a closer look at how heat moves:



CONDUCTION *(accounts for about 38% of heat lost in a typical house)*

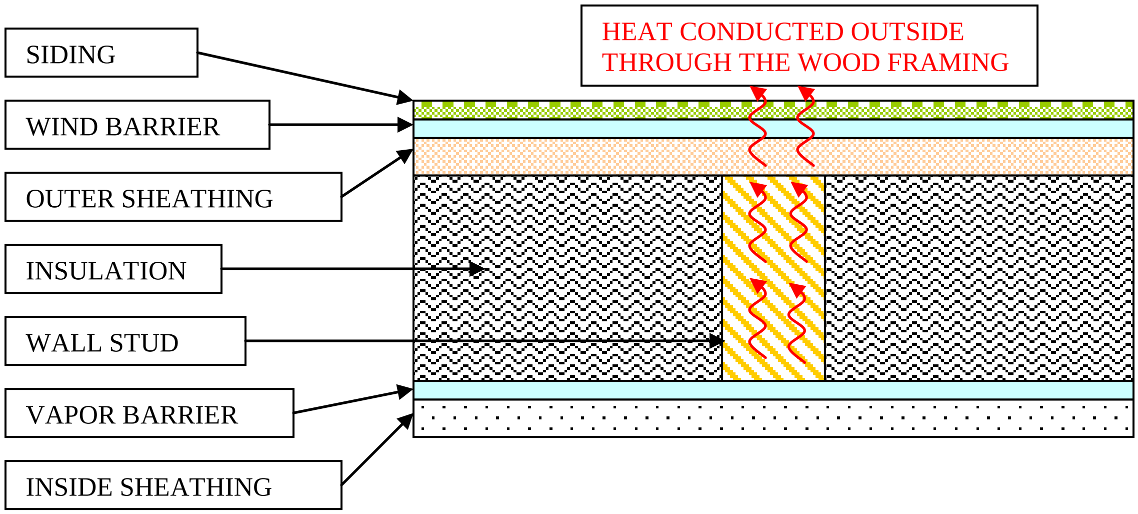
This is the process of heat moving through a solid surface, such as the structure of your house. Heat has a tendency to flow from regions of high temperature to regions of low temperature. To slow this down, you add insulation. "R" values measure the relative effectiveness of insulation; an "R 6" allows heat to move 1/2 as fast as an "R 3".



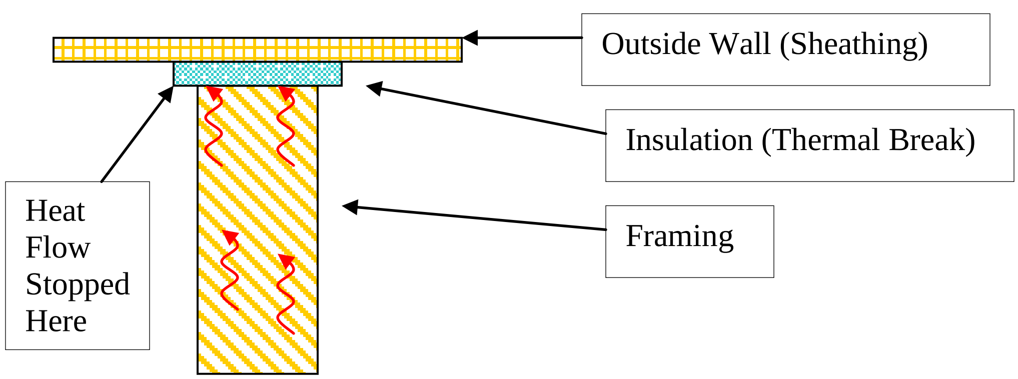
"R" Values of various materials

Item	**"R" Value**
Solid Wood 1"	1
Hollow Concrete Block	2.05
w/1" styro	7.05
w/2" styro	12.05
w/3" styro	17.05
2x4 wall w/fiberglass batt	12
2x6 wall w/fiberglass batt	19
2x8 wall w/fiberglass batt	27
Attic w/10" fiberglass batt	30
Attic w/8.5" cellulose	30
Attic w/12.5" fiberglass batt	38
Attic w/10.5" cellulose	38
Attic w/16" fiberglass batt	49
Attic w/13.5" cellulose	49
Single Pane Window	0.88
Double Pane Window	1.72
Triple Pane Low E, Inert Gas Window	4.35
Solid Wood Door	1.61
W/metal storm door	2.63
Metal Urethane Insulated Door w/ breaks	13.5

Here's the structure of a typical outside wall: (not to scale)



Wood has an average "R" value of only 1 per inch and fiberglass insulation is about 6 times greater. In a typical wall, 15-18% of its volume is solid wood, not insulation. There is also additional framing around windows and doors, adding more solid wood in these areas. So, in a typical wall with normal insulation, there are a lot of pathways for heat to conduct right through. To cut down on the heat conducting through the solid framework of the house, a modern home incorporates "thermal breaks". These are usually a part of the outer sheathing or could be insulation added between the framing and the outer wall.



While heat "conducts" evenly in all directions, more insulation is typically added to the ceiling, followed by the walls, and lastly, the floor. This recognizes the fact that heat tends to move upwards via "convection" (see next section) and that maximum temperature differences occur in above-ground surfaces that are exposed to air as opposed to surfaces in the ground. Therefore, insulation tends to be more effective the higher up it is placed.

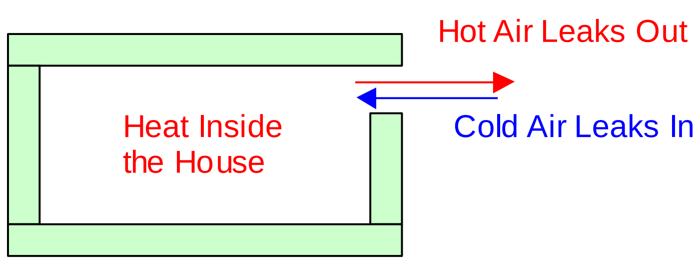
Insulation values can be determined by inspection if the areas are accessible (i.e. attic) or by an infrared camera that "sees" heat (infrared energy) leaking through. You want to have at least R30 in your attic and more is better. Visual clues will also tell you how well the insulation is doing. As an example, look at your roof on a frosty morning. It should be uniformly coated with frost. Any warm spots will melt off quickly which indicates a lack of insulation. These should be noted for further investigation. Late in the season as snow builds up, these warm spots can cause “ice dams”. Warm spots can also be caused by air leakage, which is discussed in the “Convection” section.

Inside the house, if parts of the walls are exposed, you can look at these directly to determine if its insulation is sufficient. 2 common areas that may be lacking insulation are the rim joist and the basement wall. You can also feel along enclosed walls and ceilings with a bare hand to find cold spots. Occasionally warm up your hand to keep it sensitive. Frosted areas and resulting mold build-up on walls or ceilings may be clues to a lack of insulation.

Exposed areas such as basement walls, rim joists, and attics can be insulated more easily. Finished areas, such as exterior walls and vaulted ceilings, are more expensive and difficult to add insulation. In most cases, upgrading insulation can be very expensive, but can result in significant savings to your heating bills.

CONVECTION *(accounts for about 55% of heat lost in a typical house)*

This is a process of moving heat by a fluid. For a typical house in the winter, the “fluid” is cold air leaking in and warm air leaking out. Reducing air leakage is one of the easiest and most cost-effective means of controlling heat loss in your home.



In the winter, cold outside air contains less moisture than inside air, so a good indicator of air leakage is a low indoor humidity level. On an average, if your house cannot naturally maintain a comfortable level of humidity in the winter, there is probably too much dry air leaking in. A humidity gauge is a good investment to help you to measure both moisture levels and air leakage.

Recommended Humidity Levels

Outdoor Temperature	Maximum Indoor Relative Humidity
-20 or below	15 percent
-20 to -10	20 percent
-10 to 0	25 percent
0 to 10	30 percent
10 to 20	35 percent
20 to 30	40 percent

A contractor can measure air leakage in your home by using a device called a "Blower Door". It will pressurize your house, precisely measure the amount of air leakage, and allow you to pinpoint these leaks with a smoke generator.

You can also find air leaks on your own. On a windy day, just feel along the wall, windows, doors and other likely penetrations towards the direction of the wind. Drafts indicate air leakage. You can also use a source of smoke (i.e. incense, match) to see where the air is coming in. Mark these spots for repairs later.

You can also check for air leaks on a calm day. Block OFF as many obvious air intake sources as you can, including fireplace dampers, and furnace chimneys. CAUTION: shut off gas vented appliances first! Then turn ON as many exhaust fans as you can, including the clothes dryer (on a cold temp setting) to depressurize your house. Now, dampen the back of your hand (making it more sensitive to air movement) and hold it up to obvious sources of air leaks, such as doors, windows, attic hatch and utility penetrations such as electrical boxes. Any incoming air will quickly cool off your hand, making these leaks easy to pinpoint. Mark these spots for later correction.

As mentioned before, warm air tends to rise. This can leak into the attic, melting snow on the roof and causing ice dams to form as the water refreezes. During the winter, this freeze/thaw cycle can force water under the shingles, ruining your roof, ceiling, and even the walls of your house. Attic hatches can be a common source of air leakage. Proper insulation and weather stripping is critical around an attic hatch.

You should also examine any vents or dampers for proper operation. A build-up of lint on a clothes dryer vent can prevent the damper from closing, allowing precious warm air to leak out (and critters to come in). Don't forget the vents for exhaust fans, too.

You can find an excellent selection of products designed to reduce air leakage at your favorite home improvement store. These include calking, window film, weather stripping and gaskets. Better quality products, such as silicone-based calking, will last longer and result in more energy savings than inexpensive products. Under $10 worth of products could save an average house $25 - $50 in heat. Stopping up air leaks is one of the most cost effective energy saving upgrade.

On the other hand, modern houses can be built so tight that they require mechanical ventilation to bring in sufficient fresh air, and to exhaust moisture and other indoor pollutants. Indications that your house needs more fresh air would be humidity levels over 40%, frost on the windows and noticing a musty odor when first entering from the outside.

ASHRAE Standards for Residential Ventilation

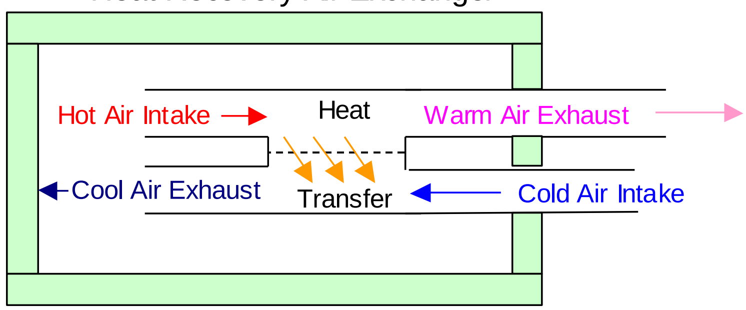
Minimum of .35 air changes /hour

-and-

At least 15 CFM (cubic feet per minute) for each person

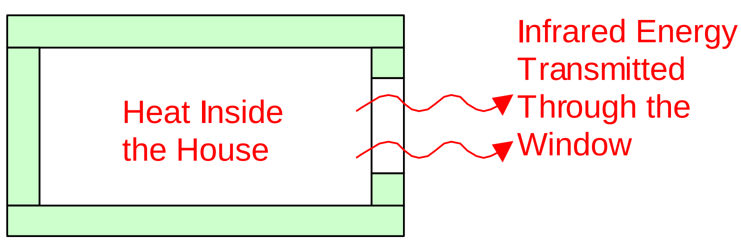
A heat-recovery ventilator is a typical solution to poor ventilation. It is designed to bring in fresh, outside air while exhausting stale, inside air. During this process, heat is recovered from the exhausted air, reducing the amount of the energy needed to condition the incoming air. This process also works in warmer weather, recovering energy from the cooler air inside your house. This device may be part of the air handling system in the house, or may be "stand-alone".

Heat Recovery Air Exchanger



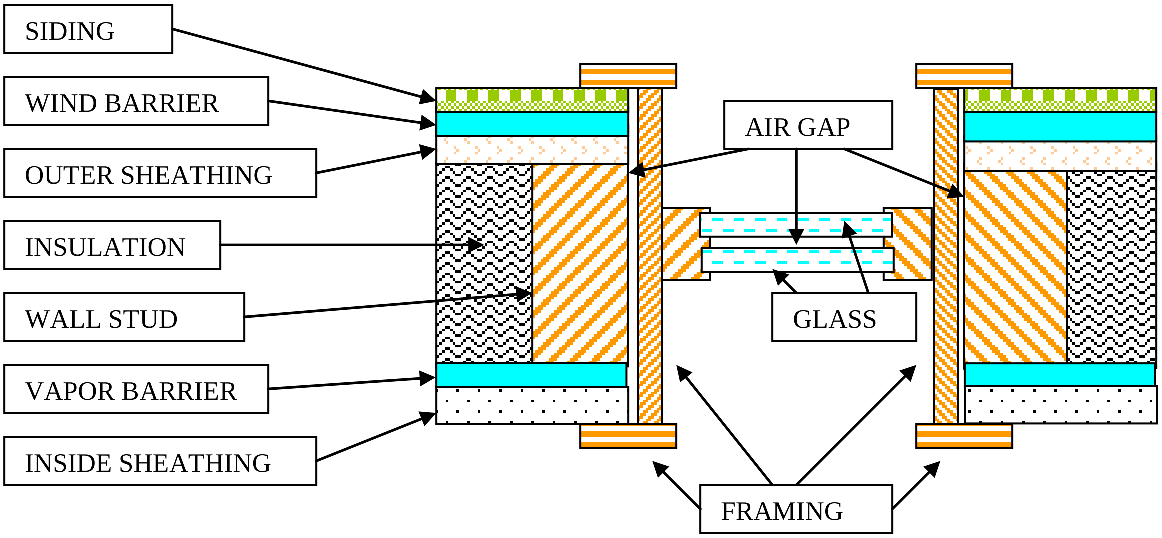
RADIATION *(accounts for about 7% of heat lost in a typical house)*

This is heat (infrared) energy transmitted in straight lines through space. Here's a common example: When you sit by a campfire, the side of your body towards the fire gets warm, while your other side does not. Likewise, if you are sitting close to a window on a cold night, you may feel the side of your body towards the window getting cold, while your other side is still comfortable.



Windows can be a significant source of radiated energy losses. You can reduce these losses by window coverings, installing low "E" (emissive) windows or eliminating the window altogether.

Here's a diagram of a typical window (not to scale):



Just like a solid wall, heat will conduct via "conduction" through the glass and the framing surrounding a window. Heat moves through windows by "convection" which is air leaking around the gaps between the framing, which can be a significant part of the entire air leakage of the house. Finally, "radiation" losses through the glass can be sizable if there is a lot of glass area.

"R" Values of Various Windows

Item	"R" Value
Single Pane Window	0.88
Double Pane Window	1.72
Triple Pane Low E, Inert Gas Window	4.35

But, windows are not inherently bad and can add to the value of your home. They let in a view of the outdoors and can be a major design element. They also add natural light and warmth during the day which can help to cut down on your energy costs (sunshine is free!). A more energy-efficient window may be more expensive up-front, but will payback this difference many times over its lifespan in reduced energy costs.

You can improve the energy efficiency of existing windows by:

- Shrink film
- Storm windows
- Weather stripping around moveable parts
- Calking trim work
- Insulating drapes or blinds

Don't forget to open the blinds on a sunny winter day; this free heat can help to lower your heating bills. On the other hand, keep the blinds closed at night or during a cloudy day to reduce heat loss through the windows. In the summertime, keep the blinds closed or use exterior awnings during the day to avoid heat build-up from the sun.

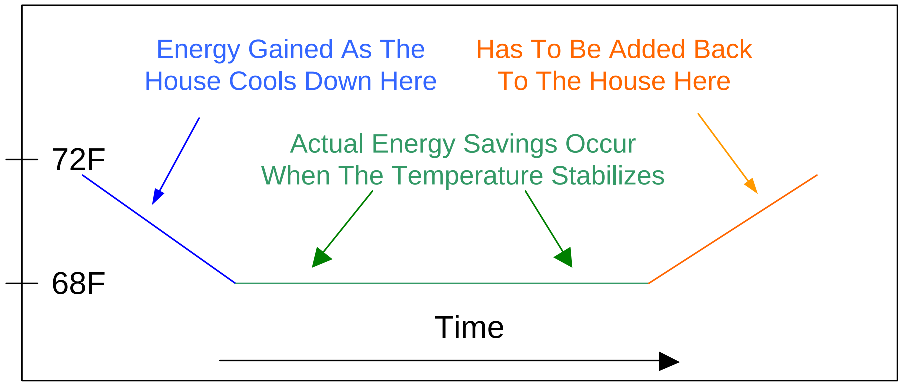
IV. OTHER STRATEGIES TO REDUCE HEAT LOSS IN YOUR HOUSE

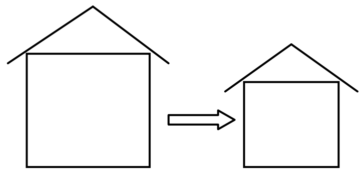
Control Inside Temperatures

Heat flow is directly proportional to the difference between the inside and outside temperatures. While you can't control the weather *outside*, you can control what happens *inside*. By setting your thermostat at a lower temperature, you can reduce the temperature difference, cutting heat loss which can result in significant energy savings. The U.S. Department of Energy estimates an average of 1% energy savings for every degree you can lower your thermostat.

Rather than maintaining a constant, lower temperature all the time, you can also lower the temperature only when you leave home or at night when sleeping, and bring it back up as needed. Programmable Setback Thermostats are designed to adjust these temperatures for you automatically.

The best energy savings come from setbacks that are at least 8 hrs or more. Here's why: It could take a number of hours for the house to cool down and a similar time for it to fully warm back up. The heat you "gain" during the cool-down time will have to be "added back" when you raise the temperature later that day. Energy savings only happen when the house stabilizes at a lower temperature. This graph shows how this works:



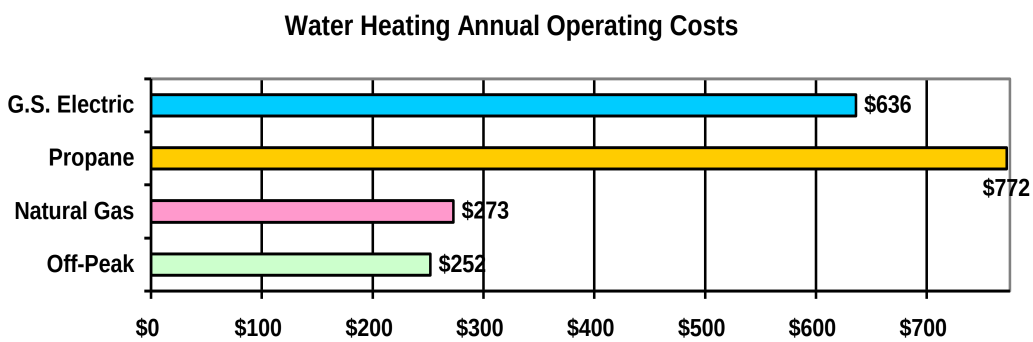
Heat A Smaller House. 

With everything else being equal, a smaller house will require less heat than a larger house. You probably won't be remodeling your existing house to decrease its size anytime soon. However, you may be able to effectively reduce the size of the heated space of your house by closing off areas that are not used in colder temps. Be sure to close off heat runs into these areas and block off airflow around doors and other openings. If heat runs go through these spaces to other parts of your house, you should insulate them; otherwise they'll still lose some heat to the space. If there is plumbing pipes in these areas, be careful they don't freeze.
CAUTION: If you block off too many air vents, this could interfere with the operation of your forced air furnace. A heating technician should be able to "rebalance" your system.

OTHER ENERGY CONSERVATION TIPS

Domestic Water Heater

After space heating/cooling, heating domestic water is the 2nd highest energy user in your home. To heat just 1 gallon of water from well temperature to 120 degrees takes about 630 BTU's. Here's the estimated annual water heating costs for a family of 4:



To manage water heating costs, here are some suggestions:

Habits

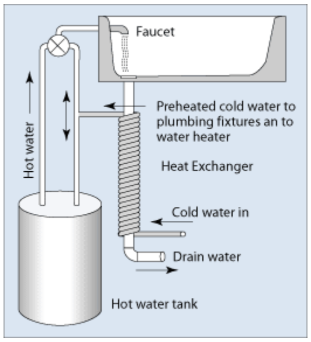
- Showers vs. baths
  A shower uses as little as 1.5 gal/minute; a bath is around 30 gallons.
- Shorter Showers
- Dish washing
- Wash clothes in cold water
- Use correct water level in washing machine

Adjustments

- Reduce temperature, 120F typical & safer. We estimate 5% savings for each 10 degree reduction.
- Mixing valves on toilets

Maintenance

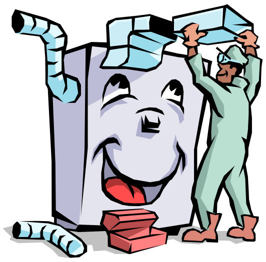
- Fix leaks, dripping faucets add up, 1 drip/second = 60 gal/week
- Insulate Pipes, don't forget cold water pipes too
- Faucet aerators/restrictors to reduce water flow
  Lo-flow showerheads use about 1.5 gal/minute (compared to 8 for standard)
- Insulation Blankets over old tanks, new models don't need extra insulation



Replacement

- Use efficient, cheaper energy source, off-peak programs
- Tankless designs not effective in saving energy
- "Point-of-Use" reduce water waste
- Heat Recovery drains
- Front-loading washing machines

MAINTENANCE TIPS



Furnace Tune-ups

We recommend that every fossil-fueled heating appliance be serviced on a regular basis by a qualified technician. They should check for:

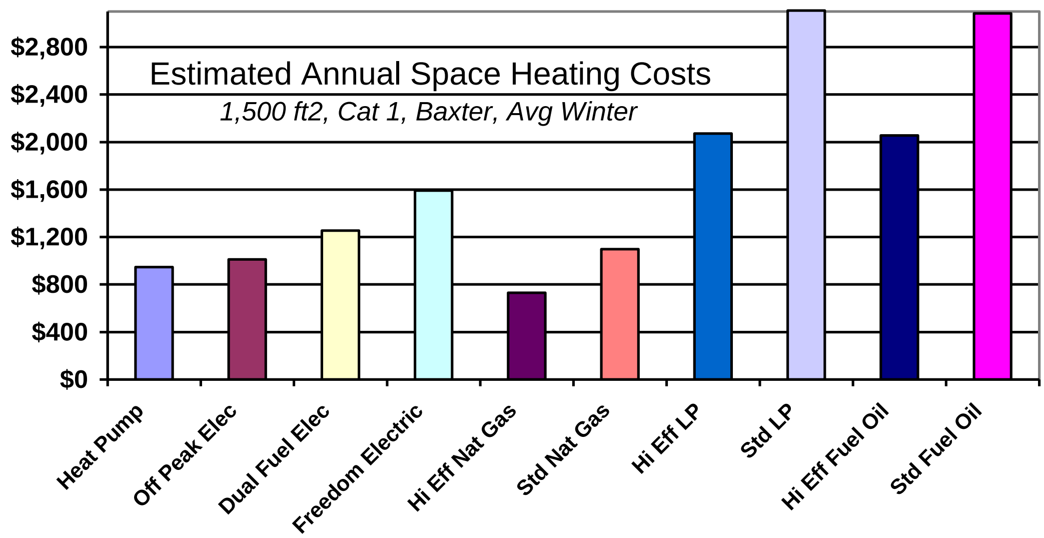
- Operating efficiency (and adjust as needed)
- Replace defective or worn parts
- Test for inside discharge of dangerous gases (i.e. Carbon Monoxide)

A homeowner can perform these basic maintenance items:

- Replace Furnace Filters
  Use a good quality filter of the same size as the original. "HEPA" or other high efficiency and allergen filtering styles are popular. Replace when visibly dirty, or on a regular basis, such as monthly during the heating season. A dirty filter not only lowers air quality by passing dirt through the house, but also restricts air flow. This restriction can increase energy usage by making the furnace run longer. It can also raise the internal temperature of the furnace, forcing more heat out the chimney and could result in a shorter furnace life.

- Housekeeping
  Clean the furnace, vent openings, and any accessible ducts of debris. Professional services can come in and clean the insides of all the ducts.
  Don't adjust air flow or block off vents unless a technician "rebalances" the system

If you are considering replacing your antiquated furnace, here's a comparison of operating costs for various heating systems:



Other Energy Users can account for about 1/3 of total home consumption

These include:

LIGHTING

By itself, lighting is not the largest single user of energy, but it does add up and is also easy to reduce. Here are some suggestions:

Turn off the lights!
Lights should be ON when needed, but turned OFF when not. This simple fact is overlooked by too many people. Switching incandescent lamps on/off frequently doesn't affect their life. However, the life of a fluorescent lamp can be shortened by switching them on/off frequently. For fluorescent lamps, a minimum of 10 minutes of operation is usually recommended for maximum life.

Downsize wattage
In many applications a smaller wattage lamp can replace a higher wattage one. This is why dimmers are so popular; people are used to buying 100 watt lamps and then dim them down to 60 watt levels. They could just buy 60 watt lamps in the first place.

Dimmers do save energy, but these savings are not as great as using the correct size of lamp in the first place.

Multi-lamp fixtures are a special case. These have maximum wattage ratings which shouldn't be exceeded to avoid fire hazards. You may be able to replace 2 smaller lamps with 1 larger wattage lamp for more brightness and less total wattage. As an example, 1 – 100 watt rated lamp is brighter than 2 – 60 watt lamps, saving 20 watts of electricity.
(2 x 60 = 120 watts – 100 watts = 20 watts saved)

Compact fluorescent lamps (CFL)
These can replace incandescent lamps for sizeable energy savings. The greatest savings result from lamps that are ON for longer periods of time. On the other hand, seldom-used lamps, such as in a closest, may not be cost effective to change to fluorescents. There is a 10 minute rule as a balance between life and energy savings for a fluorescent lamp. Cold temperatures, dimmers, and larger size can also limit the use of compact fluorescent lamps. Here are some typical savings:

Incandescent	Compact Fluorescent	Savings
25w	7w	18w ($5.26)
40w	11w	29w ($8.47)
60w	15w	45w ($13.14)
75w	20w	55w ($16.06)
100w	26w	74w ($21.61)
150w	55w	95w ($27.74)

Savings assume ON 8hr/day, @ $.10/kwh in one year's time

Automatic controls
There are a variety of products to automatically the control the operation of lighting (and other electric loads). They include:

- ✓ Timers can turn lighting ON/OFF automatically. An example would be decorative exterior lighting turning ON at dusk and switching OFF at bedtime.
- ✓ Photoeyes can turn ON security lights at dusk and OFF during the day. These are found in consumer products such as night lights.
- ✓ Motion sensors can switch lights ON/OFF based on motion and are found in security lights. These devices may also have a built-in photoeye to prevent operation during the day.

Appliances
These would include both portable and stationary appliances found in the kitchen, shop and throughout the home. For a device used infrequently and for short periods of time, such as a toaster, its energy consumption is not significant. To determine how much

energy all of your appliances may use, you should take an inventory of these along with an estimate of their run times. Standard sheets for this are available upon request.

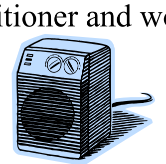
For a device in use all the time, such as a refrigerator, it pays to be aware of its energy consumption. Simple maintenance, such as dusting its coils and cleaning and adjusting the door gaskets to fit more tightly can yield some savings. Use "Energy Saving" settings whenever possible. These would include the frost-free setting on a refrigerator and the air drying feature on a dishwasher.

When replacing an old appliance, look for models that have lower energy costs (found on the yellow labeling) and/or the "Energy Star" label. Also remember that any electric device that is "OFF" will save 100% of its energy. If, for example, an old freezer or refrigerator is used infrequently, maybe it is time to pull the plug. Be sure to discard old appliances in a responsible and safe manner. While waiting for the recycler, be sure that latching doors are disabled or blocked open to prevent entrapping curious youngsters.

Also, consider the other energy inputs needed by the appliance; an example would be a front-loading clothes washer that requires less water than a conventional model. Less water equals lower water heating costs with less run time for both the well pump and sewer lift station. The premium price for a new front loader can be paid back in total savings in a very short time.

You may find similar energy savings possible with modern dishwashers, air conditioners and dehumidifiers. Since dehumidifiers can use a lot of energy, they merit special attention. These are used to control the humidity in a home and function like a stand-alone air conditioner with cold coils causing water to condense out of the moist air. However, unlike an air conditioner, they give no cooling benefit. Instead, you should be able to control humidity in the house by ventilation, reducing sources of moisture, and by running your air conditioner instead. An air conditioner reduces humidity just like a dehumidifier, while giving the added benefit of cooling the house.

You may also have energy saving opportunities in the kitchen. Instead of the oven, use the cook top, microwave, or a portable appliance to heat up food. Keep the covers on kettles to hold in their heat. Also, think of the weather when preparing food. Baking a batch of cookies on a cold winter day not only provides a tasty treat but also helps to warm up the house. However, cooking a meal in the oven on a hot summer day puts an extra load on your air conditioner and won't taste as good as grilling out on the patio.

Portable Electric Heaters 

Plug-in electric heaters are useful for areas your regular heating system doesn't cover. These come in many different styles, such as baseboards, forced fan, heating tapes, and tank heaters.

Portable heaters can also use a lot of energy in cold weather. Here are a couple of ideas on controlling their electrical consumption:

1. Is this heater really necessary? Can you insulate or seal the area so that supplemental heat is not necessary? Can you modify your regular heating system to cover this area?
2. Is this heater running as efficiently as it can? Can the temperature be set down? Can you shield the area from the wind? Can you wrap insulation around the heat tape (be sure to check manufacturer's recommendations) to reduce heat loss?
3. Is the heater operating correctly? Is the thermostat stuck "ON" or switching ON/OFF erratically? If you switched a 2-level heater to the lower setting, did the switch really work?
4. When the temperatures finally warm up, remember to switch "OFF" or unplug the heater. Don't depend upon a sticky thermostat. One way to remember to do this is to put a reminder note in your calendar to unplug the heater.
5. Be careful on "enthusiastic" sales claims on space heaters. There is little difference in efficiency between expensive and modestly priced heaters. Dramatic savings in total heating costs isn't possible by simply using a space heater.

Stand-by Power

While not as large as the normal electric loads in a typical house, "stand-by power" is becoming more significant every day. Here's why:

Most electronic devices and appliances have a digital display, battery charger and/or a remote control. Even if this device is switched "OFF", it is not totally shut down. Rather it goes into a "stand-by mode" to keep the electronics "ON" for the remote control or the digital display. While each device draws very little current during "stand-by", these tend to add up. And each house may have a dozen or more of these devices. Some examples would include:

- Cordless phone (battery charger)
- Television (remote control)
- VCR (remote control and digital display)

How significant is stand-by power? A home entertainment center consisting of a conventional TV, VCR, Video Disc Player, and Satellite TV Receiver was measured at *30 watts* of stand-by power consumption. For this one application, the power used is:

30 watts x 24 hr/day x 365 days/yr / 1000 w/kw = 263 kwh x 10¢/kwh = **$26.30 in wasted energy.**

If you added up the usage of every electric device in one household multiplied by the number of households in the country, the amount of wasted electricity becomes alarming.

So, what do we do about this problem?

When you purchase new appliances, inquire about their total energy consumption, including stand-by power. Pick your purchases based on lowest total power consumption. Maybe your new toaster doesn't really need a digital clock or a remote control.

If applicable, you can plug these devices through either a switched outlet or power strip. When not in use, you can flip the switch and totally turn these devices OFF. You won't be able to use their remote controls and will probably have to reset the clocks. But, at least you won't be wasting energy in the stand-by mode.

Generate Your Own Power

Given the high cost of energy, and our seemingly insatiable appetite for it, some people have expressed an interest in generating their own electricity. There are several methods of doing this:

- ✓ Engine-powered generators, these could use gasoline, diesel, propane, natural gas or some bio-fuel as an energy source. The conversion of fuel into electricity with a smaller size generator is not very efficient. That coupled with high fuel prices and limited capacity make engine-powered generators practical for emergency purposes only.
- ✓ Renewable energy generators can include wind and solar powered versions. A wind generator tends to be a very expensive device with lots of moving parts requiring a tall tower and a site with good wind. Solar powered devices are commonly referred to as a photovoltaic, these are smaller in size than a wind generator, have no moving parts, but cost several times more for equivalent capacity.
- ✓ Hydro electric generators use the force of moving water to create electricity. There really isn't much application or available equipment for consumer-scale hydroelectric generators.

Crow Wing Power, with other utilities in Minnesota, has provisions to buy-back excess electricity generated by consumers. However, the economics are not usually favorable in this area since the "yield" in power is very low in relationship to the cost of equipment.

For people wanting to make a difference right now, they can buy into the "Green Power" program which functions as a subscription service for utility scale wind power. The actual generators are located in southwest Minnesota, and cost of wind power is slightly higher (40¢/100 kwh block) than regular rates. But, as more people sign up for Green Power this gives the Utility capital to build additional wind capacity, driving down costs and in turn eliminating a sizeable amount of emissions from fossil fuel generators.

On average, here are the emissions produced by generating a kilowatt of electricity:

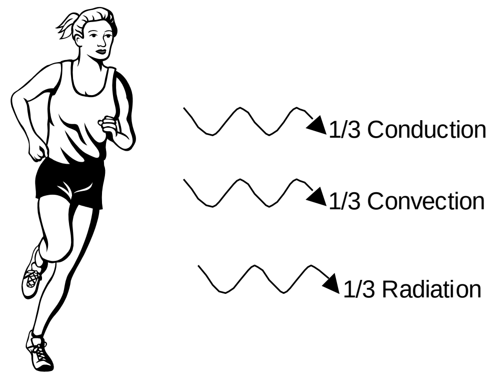
1.5 lbs CO_2
.006 lbs Nitrous Oxide
.013 lbs Sulfur Dioxide

For the average consumer, signing up for Green Power is a direct means to improve our environment. Conserving energy is another way to have this same effect. For every bit of electricity not used, that translates into electricity that doesn't have to be generated, reducing its associated environmental costs.

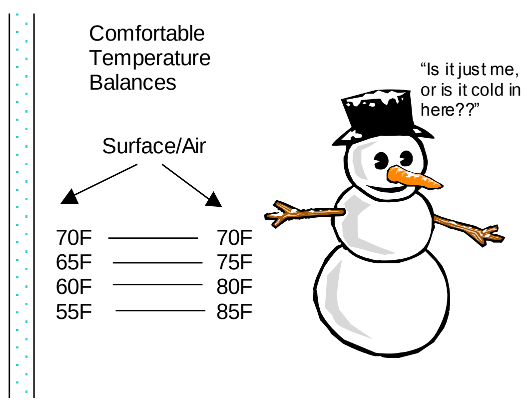
HUMAN FACTORS

Up to now, we have been mostly considering energy requirements of your home assuming it is an empty box. However, your house and its various systems exist to serve the needs of its occupants. Humans have their particular quirks in respect to these needs.

- Here's how heat flows from a typical human body:



- This differs from how "measured" heat typically moves out of the house, namely 38% conduction, 55% convection, and 7% radiation. The body "feels" radiated heat loss is as significant as convection, which is contrary to our "measurements".
- Knowing how heat flows from a human body is important in understanding "Temperature Balance". This is the ratio between air temperature and the surrounding wall temperatures. Most people are comfortable with these ratios:



- In other words, if the surrounding walls are colder, more heat is removed from the body, primarily through radiation. As a result the air temperature has to be higher to compensate. Here's an example; in a basement with a 55 degree wall surface temperature, the air temperature would have to be set at 85 degrees to "feel" as comfortable as a balanced 70/70 degree room.

- Generally, here are some values where most people are comfortable:
  - ✓ Humidity range from 40-50%
  - ✓ Temperature range from 68-72F
  - ✓ Air movement below 10 mph

- Each person is a little different
  - ✓ Some people may be comfortable outside these ranges
  - ✓ This can be a source of friction with other occupants

- Dress for the season
  - ✓ The human body can tolerate a wide range of conditions when dressed appropriately.
  - ✓ In the winter, it is normal to wear more clothing to retain body heat. This allows for lower room temperatures.
  - ✓ Summertime clothing allows a higher room temperature with acceptable comfort.
  - ✓ If people don't dress appropriate for the season (i.e. wear sweaters in the summer), then heating/cooling requirements in the home may have to be adjusted. This can waste a great deal of energy.

- People add moisture and heat
  - ✓ In an office setting, each person adds about 550 BTU's/hr. Different sized people and different activity levels will affect this (i.e. dance hall).
  - ✓ Occupants also add moisture through their breath and skin.
  - ✓ If the relative humidity of the air is too low (less than 40%), then excessive moisture can be lost through the skin, creating a cooling effect. Interior temperatures may have to be set higher to feel comfortable.

- "Windchill"
  - ✓ Air moving past the skin will help to strip away heat and moisture. This is useful in warm temperatures to cool you down. However, in the winter, noticeable air movement tends to cool you down even if the air temperature is at normal levels.

- Habits
  - ✓ We can affect comfort and energy usage by how we use our home and its systems. Examples would include:

    -Sleeping with a window open for "fresh air" even during extremes in temperature.
    -Frequent fiddling with the thermostat, causing wide temperature swings and wasting energy
    -Excessive use of a dehumidifier, even when humidity levels are already low or are being controlled by the air conditioner.

SUMMARY

To understand and manage your energy usage requires you to understand:

- Energy Costs
- Climate Trends
- Your History
- How Heat Moves
- Appliances
- How Occupants Affect All These

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