Around the House
Home Repair and Remodeling

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Does Lowering Your Thermostat Actually Save Money?

I've seen several discussions lately about whether it actually saves any money to set your thermostat to a lower temperature. The argument typically includes arguments about how "hard" your furnace will work at different thermostat settings, the loss of stored heat in furniture, walls, etc., and a theory that it takes just as much fuel to raise the temperature again as it would have to maintain the temperature. I've spent considerable time thinking about the issue and looking at the literature I could find on-line.

I must give the disclaimer that all of my thoughts on this issue relate to "normal" furnaces and boilers. I know very little about heat pump systems. They may work very differently and, therefore, require a different mindset regarding temperature control.

For those of you who would like to "cut to the chase," I believe that you never will lose money by setting your thermostat back and much of the time you will save something. We have owned an automatic setback thermostat since we first bought our house, decades ago. We have told the thermostat when we think that we generally go to bed, get out of bed, leave for work in the morning, and return again in the evening. It is simple to override these settings if we should happen to be home during a day that it thinks we should be gone or if we want to stay up later.

I've always thought that thermostats should be linked to the front door lock or alarm system. After all, you lock the front door and/or set the alarm when you leave and when you go to bed. You unlock the front door and/or turn the alarm off when you return and when you arise in the morning. These are precisely the times when you would like to change the thermostat setting.

Now for the explanation of why I believe the preceding. The following discussion assumes we are discussing a heating period (i.e., the temperature inside your home is the higher than the outside temperature). The same discussion works for a cooling period, but all the directions of heat transfer are reversed (that is, your home's "heat leaks" are now entering rather than leaving). When I write "furnace," I also include boilers, electric baseboard heaters, etc.

Think of your home as a poorly sealed "tank" of these little things called BTU's. Your home will leak BTU's to the outside because there are fewer of them out there. The higher the concentration of BTU's in your home, the warmer it feels to you.

You have lots of things in your home that manufacture BTU's. Your oven, toaster, water heater, even your radio and television, but we will ignore all of them except the one that is designed to specifically manufacture BTU's for the general living space … the furnace. Your thermostat is a device to test the concentration of BTU's in your home and control the furnace's manufacture of BTU's to maintain that concentration.

When the concentration of BTU's in your home drops below the level you've told your thermostat to watch for, it tells your furnace to make more. The furnace turns on full blast and produces as many BTU's as it can until the thermostat decides that the concentration is high enough again and tells it to stop making BTU's. Since your furnace works at full throttle whenever it is on, your cost is directly related to how long your furnace runs.

So how do we save money?

You could work at sealing up or reducing the BTU leaks. Insulating, replacing windows or doors, and sealing gaps will keep more of the BTU's in your home. If there are fewer BTU's leaking from your home, the furnace will have fewer to replace.

You could replace or supplement your furnace with one that uses less (or cheaper) fuel to produce a BTU. For example, your old oil guzzling monster uses $1,000 worth of fuel to make the same number of BTU's that a pellet stove can make with $800 worth of pellets.

But those are the simple things to understand. What about the idea of lowering your thermostat? I propose that how much you spend on heat is directly related to the temperature differential between the inside temperature and the outside temperature and time.

If you set your thermostat and left it alone, your heating bill would be directly related to the outside air temperature (ignoring things like solar gain on sunny days, etc.). As the outside air temperature falls, the temperature differential between the inside and the outside grows, more BTU's leak out, and your furnace is called upon to manufacture replacements.

To lower your bill, reduce the amount of time your furnace runs. To reduce the amount of time your furnace runs, either fix the leaks or reduce the temperature differential. I don't know how to raise the outside temperature, so we'll have to reduce the inside temperature.

We know this makes sense in the extreme. If you were going to leave on a month long vacation, you would turn your thermostat down and expect to have lower fuel bills than if you were home and keeping the temperature at a more comfortable level. But what if you were going to the convenience store for milk? You wouldn't think of doing it then as the temperature might not fall enough inside your home for the furnace to even kick on in the time you are gone. But what if you did? You would use exactly the same amount of fuel because the furnace would have run exactly the same amount of time.

So, what about lowering the temperature for a number of hours while you are away at work or tucked under your warm bed sheets? Let's return to the "tank" model.

For simplicity, let's assume that the outside air temperature stays constant at 0 degrees Fahrenheit. Just before you hop into bed, you turn your thermostat down from 68 degrees to 63 degrees. As the concentration of BTU's inside your house drops, fewer BTU's will leak out because the temperature differential is going down. Think of every degree of temperature inside your house the same as a degree rise in temperature outside.

At some point the model will stabilize because the concentration of BTU's will reach 63 degrees and the thermostat will have to start telling the furnace to manufacture BTU's to replace those which have leaked out. Remember, they are leaking at a reduced rate because of the reduced temperature differential. Fewer BTU's will need to be manufactured for the entire time the house is at 63 degrees. Yes, you will need to produce a whole lot more in the morning to bring the concentration back up when you ask the thermostat to keep the home at 68 degrees. But you produced none at all in the time that the home cooled off from 68 degrees to 63 degrees.

Now, it's time to leave the house for the day. The temperature will be warmer during the day (let's assume that it jumps to 40 degrees just before you leave the house and remains there until after you return home), but the theory is the same even if it isn't warmer. Again, you tell the thermostat to only make more BTU's when the concentration has dropped below 63 degrees. All the same things occur as the paragraphs above, but this time, you return home when the concentration is at 64 degrees. All day long your furnace didn't have to manufacture any BTU's because the thermostat never detected that the BTU concentration had dropped below the critical level. When you turn up the thermostat, the furnace must produce enough BTU's to replace all those that leaked out during the day, but it will be fewer than if the thermostat was trying to keep the higher concentration as they leaked out at a slower and slower rate.

The above doesn't include any discussion about heat lost from your furniture or walls. BTU's that are "stuck" to your walls, furniture, etc. don't matter. The only BTU's that matter are the ones that leak to the

outside and are lost. The ones stuck to your stuff get given up as the concentration of BTU's drops and, slightly, slows when the thermostat will need to call for more BTU's to be manufactured. Yes, more must be produced as BTU's get "re-stuck" to your stuff, but not more than were given up to help keep the concentration up as it dropped earlier in the day.

I know this was a long way to come, but hopefully, I've been convincing in my argument that you will not use more fuel in any situation where you have lowered your thermostat. The more you lower it and the longer you lower it, the more you will save.

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