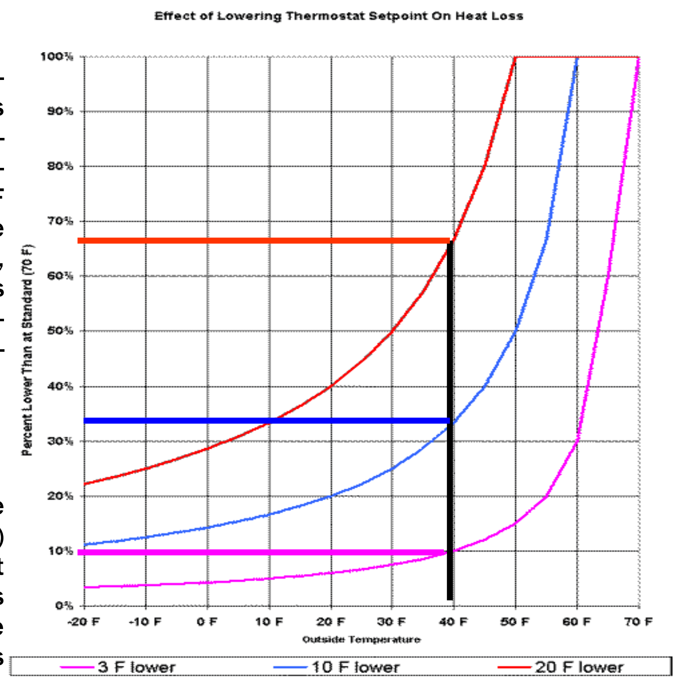
Setback Temperature Control

Utility Savings Initiative (USI) - Fact Sheet

Introduction

Space heating and cooling accounts for over 50% of the energy use in a building. One of the most cost effective means of reducing energy consumption is by setting the temperature back when the building is unoccupied. Typical thermostats are set between 65°F to 70°F for heating and 72°F to 78°F for cooling. These settings vary depending upon the age of occupants, their activity level, the relative humidity, the air tightness of the building, and specific energy policies of the building owners. DOE projects an energy cost reduction of 5% - 12% with a 3°F to 10°F setback and a 9% - 18% energy cost reduction with a 10°F to 20°F setback.



Heat Loss and Setback Temperature

The graph at the right shows the effect a given temperature difference between a room set point temperature (70°F) and outside air temperature (70°F to –20°F) has on heat loss. A lower setback temperature results in less heat loss as the outside temperature drops through the night. The energy savings is much greater during the warmer months of the heating season, and less pronounced during the coldest time of the year. This graph is only representative for a heating load, as cooling loads are much more dependant on the Sun's radiant energy influence and building fenestration. From the graph it shows that a 20ºF setback will result in a 67% lower heat loss than if there was no setback at all. The 10ºF setback would result in a 33% less heat loss than at 70ºF and the 3ºF setback would only save about 4% of the energy loss as compared to no setback at all. How much to setback is often evaluated in terms of the building envelope's rate of heat losses (U) and the hvac equipment sizing capacity for next day loss recovery. However, the next day loss energy recovery is normally less than the heat loss if no setback had taken place, unless the building is poorly insulated.

Setback @ 70 °F	Outside T 40°F	ΔT	Heat Loss Q=UAΔT
3 °F	40 °F	(67 - 40) °F	Q =**UA**(27 °F)
10 °F	40 °F	(60 - 40) °F	Q =**UA**(20 °F)
20 °F	40 °F	(50 - 40) °F	Q =**UA**(10 °F)

Estimating Cost Savings From Setbacks

It is possible to estimate cost savings resulting from a temperature setback to a building/area zone or room knowing the energy cost and climate conditions prevailing during the time period of energy cost billings. Suppose for the month of February the building or rooms consumed 50% of the electrical billing (for ventilation fan power, hydronic hot water pump power, and control regulation power) of 21,200 kWh @ $0.086/kwh = $1,823. Additionally, natural gas consumption was 1,950 therms at $1.16 /therm or $2,262. The total heating bill for the month would be $3,174. Based upon an average temperature of 40 °F what is the cost savings for a 3 °F, 10 °F, and 20 °F setback at night. Since the unoccupied portion of the day is 14 hours in 24 hours or 58 % of the heat loss should be allocated to the nighttime setback energy use or

11 pm – 6 am	6 am – 4 pm	4 pm – 11 pm
Setback	**70 °F**	**Setback**

$1,841 for the month of February. If there were no change in setback then the energy losses would cost $1,841. At 3ºF the cost savings would be $1,841 — ($1,841 x 0.9) = $184 and similarly $607 @ 10ºF Setback and $1,233 at 20ºF.

Setback Strategies

Setbacks temperatures are often dependent on recovery time of the hvac equipment capacity to reestablish the normal occupied building temperature prior to people arriving for work or students for school. The worst case scenario is when a sustained extreme temperature excursion below (winter) or above (summer) the setback temperature for a short period of time (several days). Under these conditions hvac capacity will determine the transitional time to reach occupied building setpoint and thus probably an earlier start in the morning for ramping to the accepted room temperature. Additionally, it is important for the larger hvac equipment horsepower motors to be started sequentially with non-overlapping run sequences to prevent demand electrical charges.

Programmable Thermostats/Energy Management Systems

Thermostats typically control room (s) temperature within a relatively narrow band (2°F to 3°F) by activating the cooling and heating system. Programmable thermostats allow the building operator to vary the building temperature automatically based upon building use. By setting the temperature back during the unoccupied periods of summer cooling and winter heating energy can be reduced. While a variety of styles and brands are available, they can be classified into the following three types.

Electromechanical Thermostat - use an electrical clock and a series of pins and levers to control temperature. This is usually the least expensive with ease of operation but have limited flexibility.

Digital Thermostat - offer more flexibility to tailor settings to differing schedules for different days of the week or up to 4 setpoints per day.

Occupancy Sensor Thermostats - maintain the setback temperature until triggered by a person entering the controlled space. The trigger mechanism can be a switch, button, light, or motion sensor.

Energy Management Systems - have applications on larger buildings with multiple scheduling requirements and with several hvac cooling and heating systems. Typically, the setback temperatures are weighed against available equipment efficiencies, optimum electric power rate savings, and temperature ranges that are adaptive to climate changes. Manufacturer's control strategy and building use requirements. It is no doubt the most difficult

Home Applications - Programmable Thermostats

Did you know that properly using a programmable thermostat in your home is one of the easiest ways you can save energy, money, and help fight global warming? An ENERGY STAR qualified programmable thermostat helps make it easy for you to save by offering four pre-programmed settings to regulate your home's temperature in both summer and winter — when you are asleep or away.

The average household spends more than $2,000 a year on energy bills — nearly half of which goes to heating and cooling. Homeowners can save about $180 a year by properly setting their programmable thermostats and maintaining those settings. The pre-programmed settings that come with ENERGY STAR qualified programmable thermostats are intended to deliver savings without sacrificing comfort. Depending on your family's schedule, you can see significant savings by sticking with those settings or adjust them as appropriate for your family. The key is to establish a program that automatically reduces heating and cooling in your home when you don't need as much. Use the ENERGY STAR Programmable Thermostat Calculator to see what you can save with set-back temperatures that work for your family. The pre-programmed settings for an ENERGY STAR qualified programmable thermostat are:

Setting	Time	Setpoint Temperature (Heat)	Setpoint Temperature (Cool)
Wake	6:00 am	≤ 70° F	≥ 78° F
Day	8:00 am	Setback at least 8° F	Setup at least 7° F
Evening	6:00 pm	≤ 70° F	≥ 78° F
Sleep	10:00 pm	Setback at least 8° F	Setup at least 4° F

Reference:
http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=TH

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