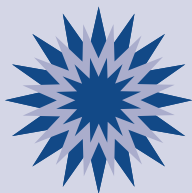
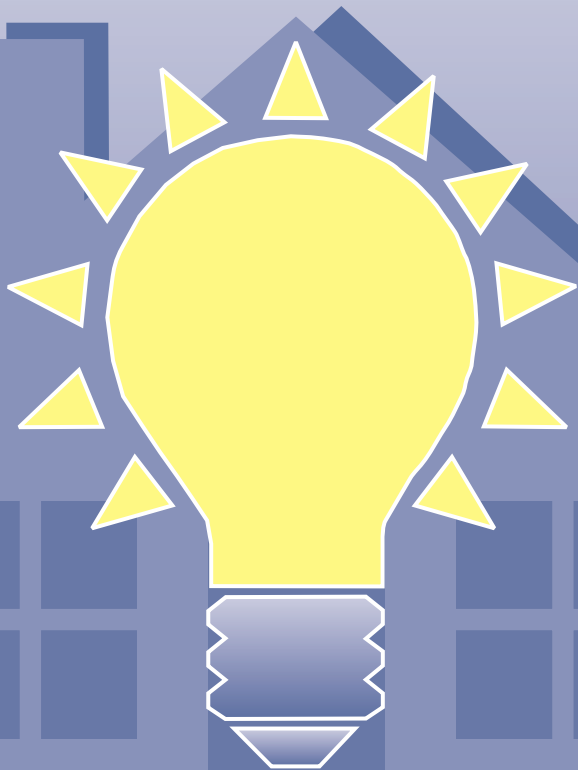


# ELECTRIC IDEAS

## HOME HEATING



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# ELECTRIC HEATING SYSTEM GUIDE

## ...finding the best system for your needs.

This guide has been designed to help you understand and compare different electrical heating systems so you can choose the best system for your needs. Both central and zonal systems are discussed with each section addressing:

- A description of the system
- Advantages and disadvantages
- Controls
- Maintenance
- Efficiency
- Ease of operation

You will find helpful information about our features on the final pages. For additional information, please contact our utility office.

**SAMPLE**

# ZONAL HEATING SYSTEMS

Unlike a central heating system, zonal heating allows you to adjust the temperature at varying levels throughout the house.

Zonal heating with individual units in each room (or zone) is a popular choice in homes. Separate thermostats give you the flexibility to control areas to be heated providing maximum comfort in every room. Zonal heat can also take advantage of passive solar heat allowing the sun to warm certain areas of the house without affecting the entire system. Planning for a zonal heating system must start early because the system depends on the design of the building shell and the floor plan.

A zone, in the typical home, would be defined as any area isolated from other areas by partitions or doorways. For instance, each bedroom is usually a separate zone. A typical 3-bedroom, 2-bathroom home might need seven or eight zones. Homes with more than one floor plan will have fewer zones. There can be more than one heater in a zone controlled by a single thermostat.

## ADVANTAGES

- Generally less expensive than a central heating system.
- Takes better advantage of passive solar heat.
- Heat can be reduced in lesser used rooms more effectively.

# CENTRAL HEATING SYSTEMS

A central heating system allows you the convenience of adjusting the temperature throughout the house from one thermostat.

The one weak point of a central system is leaky ductwork if it's located in an unheated space. Studies have shown that these ducts, which are typically insulated but not sealed, can account for a large percentage of heat loss. When you design your home heating system, whether it's a new home or an add-on system, duct sizing and heat loss will play a big role in the efficiency of the heating system.

Central heating systems can also include cooling, either using a heat pump which provides heating and cooling, or a forced air furnace which will accommodate a central air conditioning system. These systems allow you to heat and cool your home with one thermostat and one duct work.

Controlling your central system can be automated by including a programmable thermostat which can be set according to your daily schedule, automatically increasing or decreasing the temperature.

## ADVANTAGES

- A single thermostat controls heating and cooling for the entire house.
- Air filtration system removes dust and dirt from the indoor air. Filters should be changed or cleaned regularly for efficiency.
- Ductwork can be included as part of the whole house system.

# FAN ASSISTED WALL HEATERS

**SYSTEM DESCRIPTION:** The same principle applies to this system as to a forced air system. The only thing missing is the ductwork—the weakest part of a forced air system. These self-contained heaters are mounted in a metal box containing a heating element and a fan. The fan draws air into the unit, blows it across the element, and warm air enters the room. The units range from 500 to 3,000 watts in a variety of dimensions allowing great flexibility.

## ADVANTAGES

- As with all zonal systems, you can heat only occupied rooms.
- Inexpensive to purchase and install.
- Provides good air circulation.
- Quick warm up.
- Wide variety of wattages.
- Small, compact units don't take up much wall space allowing easy furniture arrangement.
- New electronic models are set based on heating needs.

## DISADVANTAGES

- Fans can be noisy.
- Poor location in close proximity to the floor may cause a safety concern if used by combustibles.
- In most cases several thermostats are needed to adjust the temperature of the entire house.

**MAINTENANCE:** Since there isn't a fuel being burned, it is a very clean system. Maintenance from a heating contractor is seldom needed. Air filters should be cleaned or replaced regularly

**EFFICIENCY:** Electric resistance heat is 100% efficient. For every watt of electricity the system consumes, a watt of heat is created. The weak point of a forced air system is the ductwork (see Ductwork section). If possible, try to place all ductwork within the heated space. If not, make sure all seams and joints are thoroughly sealed and ducts are properly insulated.

**CONTROLS:** (See additional information in Thermostat section) In most cases, a single thermostat can control the entire system. To improve comfort, an electronic thermostat is a great idea. It will narrow the gaps between the high and low temperature swings.

It is recommended that the thermostat being turned down while sleeping, or when the house is vacant for four hours or longer. A programmable thermostat allows you to set the temperature according to your daily schedule, saving on your heating costs.

**EASE OF OPERATION:** With a programmable thermostat, this system is simple to control. If you have a standard thermostat, it is necessary to manually reduce the temperature while sleeping and during times when the house is unoccupied for at least four hours.

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**CONSIDERATIONS:** Clean or replace the air filter on a regular basis (monthly). Check for blockage at the registers for things dropped into the ductwork. Vacuum the ductwork occasionally or have it professionally done to remove dust and particles.

# BASEBOARD SYSTEM

**SYSTEM DESCRIPTION:** Baseboard heaters, as the name implies, are installed where the wall intersects the floor. These heaters have been used for many years in a wide variety of applications. Not requiring ducts, motors, or fans, they operate by drawing natural convective air currents from the floor (where the air is cooler) across an electric element with several fins (some models have liquid-filled elements). The heated air flows out of the top of the baseboard and radiates into the room.

When purchasing baseboard heaters, select the "low density" models (not more than 250 watts per lineal foot). This provides a more even heat distribution and prevents dark smudges from airborne particles settling on the wall. Also, choose a quality product and insist on construction features that eliminate snapping and popping noises caused by the thermal expansion and contraction of the components.

## ADVANTAGES

- As with other zonal systems, each zone (or room), can be heated to different temperatures.
- Inexpensive to purchase and install compared to other heating systems.
- Baseboard heaters are versatile. They can be installed in various types of construction.
- No heat loss through ductwork.
- Low maintenance.
- Quiet to operate.

## DISADVANTAGES

- ▣ Their large size may make it difficult to arrange furniture without blocking the heater.
- ▣ Being located in close proximity to the floor may cause a safety concern if blocked by combustibles.
- ▣ In most cases several thermostats are needed to adjust the temperature of the entire house.
- ▣ Dark smudges may appear on walls due to improper maintenance.
- ▣ May make snapping or popping noises when heating up.

**MAINTENANCE:** Turn off the electricity and vacuum heaters regularly.

**EFFICIENCY:** Electric resistance heat is 100% efficient—for every watt of electricity the system consumes, a watt of heat is produced. Comfort may be reduced due to furniture blocking the air flow or poor design.

**CONTROLS:** (See additional information on Thermostat section) Typically, an inexpensive bi-metal coil sensing thermostat is used to operate each zone. This type of thermostat allows the temperature to fluctuate as much as five degrees on either side of the thermostat setting. An electric thermostat, however, will maintain a more comfortable temperature, within one to two degrees of the setpoint.

**EASINESS OF OPERATION:** Individual room temperatures are easy to control, however, managing the whole house as a system, it can be time consuming to ensure that each thermostat is turned down when needed. A master control thermostat can be used to control multiple rooms more effectively.

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**CONTROL TIPS:** For optimum efficiency, reduce the thermostat setting while sleeping or when the space is unoccupied for four or more hours.

# RADIANT HEATING SYSTEMS

## Ceiling Cable Heat, Radiant Floor Systems, and Wall Cove Heaters

**SYSTEM DESCRIPTION:** Radiant heating can be installed in the ceiling, walls, or floor of a new home. All of these systems radiate heat toward objects, including occupants, in the heater's line of sight, without heating the air in between. It works much like direct sunlight on a cold, windy day. Since radiant systems can keep occupants comfortable at lower air temperatures they may reduce heat loss from the home when the heat is on for short periods. If the heat is on for long periods of time the air temperature in the zone will rise to the same temperature as the floor zone systems.

Depending on your living habits radiant heating units can be quite energy efficient.

Ceiling heat is the most common form of radiant heat. Cables attached to the sheetrock or plaster are common in older homes. Newer improved designs use continuous conductive mats that spread the heating over an entire panel, which is easier to install or replace, and also less likely to need repairs. Ceiling radiant heat is only slightly more expensive than most baseboard systems and technological advances have made it much more reliable than in the past.

Radiant heating can also be installed in the floor, which some consider the most comfortable electrical heating option of all. However, floor radiant heat can be expensive to install, and requires sophisticated controls to prevent overheating.

Another type of radiant heating system is a cove heater. This system consists of a long, narrow radiant heater installed high on the wall of each zone.

## ADVANTAGES

- High comfort level.
- Commonly a zonal system, but can be centralized.

## DISADVANTAGES

- Potentially high installation costs.
- In most cases several thermostats are needed to adjust the temperature of the entire house.

**MAINTENANCE:** Ceiling cable heat systems can be damaged by attaching things to the ceiling (plant hooks, etc.). Relatively maintenance free.

**EFFICIENCY:** Electric resistance heat is 100% efficient — for every watt of electricity the system consumes, a watt of heat is created. Efficiency may be reduced due to poor system design. It is important to reduce heat loss by insulation when sizing the system.

**CONTROLS:** (See additional information in Thermostat section) Typically, an inexpensive bi-metal coil sensing thermostat is used to operate each zone. This type of thermostat allows the temperature to fluctuate as much as five degrees on either side of the thermostat setting. An electric thermostat, however, will result in a more comfortable temperature environment within one to two degrees of the set point.

**EASINESS OF OPERATION:** Individual room temperatures are easy to control, however, controlling the whole house as a system, it can be time consuming to ensure that each thermostat is turned down when needed. A master control thermostat can be used to control multiple rooms more effectively.

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**CONTROL TIPS:** For optimum efficiency, reduce the thermostat setting while sleeping or when the space is unoccupied for four or more hours.

# FORCED AIR SYSTEM

**SYSTEM DESCRIPTION:** If you think of winter comfort as circulating warm air, then the electric forced air system is right for you. This compact unit can be installed almost anywhere in your home and it can even be hooked up to electric air conditioning for cooling. An electronic air cleaner can also be added. The system consists of: the furnace, which contains controls, heating elements, and a fan; the supply ducts, which distribute the heated or cooled air; the return ducts, which deliver air from the house back to the furnace for re-heating; and the thermostat, which directs the furnace to heat to a preset temperature. If air conditioning is part of the system, the same thermostat can direct cooling.

## HOW DOES IT WORK?

The thermostat senses the house has cooled off, it signals the furnace to energize a series of heating elements, and it blows over the elements. The warm air is circulated through the supply ducts, exiting at registers throughout the house. The cooled air is drawn through return air ducts (usually located in the ceiling) and passes through a filter to clean out particles, then back through the elements for reheating.

## ADVANTAGES

- ▣ Central system heats the entire house to the same temperature.
- ▣ Heating and cooling registers take up very little space.
- ▣ A single thermostat can control the entire house.
- ▣ An air filtration system cleans the re-circulated air.
- ▣ Quiet, clean, and safe. No flames, fumes, or chimneys.
- ▣ Central air conditioning can easily be added.

## DISADVANTAGES

- ▣ It's not recommended to close off rooms in the house.
- ▣ Costs more to operate than a heat pump.
- ▣ Not designed to be used as a zonal system.

**MAINTENANCE:** Turn off electricity at the breaker, remove grill and vacuum dust from the heater on a regular basis. Grills should be washed when removed. Some fan motors require occasional oiling, others are self-lubricating.

**EFFICIENCY:** Electric resistance heat is 100% efficient – for every watt of electricity the system consumes, a watt of heat is created. These fan-forced systems heat rooms more rapidly than other zonal systems. Efficiency can be increased with new electronically-controlled fans available on some newer models.

**CONTROLS:** (See additional information in Thermostat section.) Typically, an inexpensive bi-metal coil spring thermostat is used to operate each wall heater. These thermostats allow the temperature to fluctuate as much as five degrees on either side of the thermostat setting, leading to uncomfortable rooms. The heating system usually goes on the same. Consider an electronic thermostat to maintain the temperature within one to two degrees of the setting, creating a more comfortable environment.

**EASE OF OPERATION:** Controlling heaters in individual rooms is very easy. However, considering the whole house as a system, it can be time consuming to assure that each thermostat in each room is turned down when needed. A master thermostat can be used to control multiple zones.

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**CONTROL TIPS:** For optimum efficiency, reduce the thermostat setting while sleeping or when the space is unoccupied for four hours or longer. A master thermostat can be used to control multiple zones at one time.

# HEAT PUMP SYSTEM

**SYSTEM DESCRIPTION:** There are three types of heat pumps: air source, ground source and water source. Heat pumps work on the principal that heat exists in the air, soil, and water outside your home. The heat pump doesn't create heat like conventional heating systems. It moves heat into your home in the winter (heating cycle), and cool air into your home in the summer (cooling cycle). In the spring and fall months with cool mornings and warm afternoons, the heat pump can automatically switch from heating to cooling.

The AIR SOURCE heat pump is the most common, it extracts warm or cool air from the outside and brings it into your home. The air source system is the least expensive of the three. GROUND SOURCE, as the name implies, moves heat from pipes buried in the earth either horizontally or vertically. WATER SOURCE moves heat from water. The water source system usually operates from a well, but some systems use a source of water from a pond, lake, or river. Generally speaking, the water source heat pump is the most efficient system.

## HOW DOES IT WORK?

**The Heating Cycle:** A liquid refrigerant captures the heat from the outside air, soil, or water. The heat causes the liquid to warm and turn into a cool gas. The change from liquid to gas creates large amounts of energy. The refrigerant now a cool gas, is too cool to warm the house—that's where the compressor comes in. It compresses the gas raising the temperature drastically. This hot gas moves past the indoor coil, giving up it's heat and turning back into a liquid. A fan blows over the indoor coil and distributes the heat into your house through a ductwork system. The mixture of warm liquid and gas continues through the expansion valve, which reduces the pressure, causing the refrigerant to become a cold liquid ready to start the cycle all over again.

## ADVANTAGES

- Generally costs less to operate than all other types of heating systems.
- Operates at a high-efficiency with no flames, fumes or chimneys.
- Filters are available to remove mold and mildew, which is helpful for those with allergies.
- Provides a more constant, even temperature, without the swings common to other heating systems.

- Maintains comfortable temperatures year around.
- Heats and cools the home.
- Transfers heat already in the environment.
- Can provide supplemental water heating.

## DISADVANTAGES

- Larger investment than an electric furnace.
- May cost more to service and repair than other electric heating systems.
- Some outdoor units may be noisy.

**MAINTENANCE:** Air filters should be cleaned or replaced regularly. Clear debris from around the outdoor unit to allow proper air flow. Have a heat pump contractor perform a periodic service of the system. An annual service agreement is a good idea.

**EFFICIENCY:** Heat pump efficiency is rated in two ways: Heating Season Performance Factor (HSPF) and Co-Efficient of Performance (COP). In both cases, the higher the rating, the more efficient the system. Contact our office for recommended efficiency ratings.

1. HSPF takes into account differences in efficiency due to temperature fluctuations, ducting, leaks, supplemental heat, and on/off cycles. Divide the HSPF by 3.4 to determine the average COP.

COP compares the energy output of a heat pump to its energy input. A COP of 2.0 (air source heat pumps) indicates there is twice as much heat energy being delivered by the heat pump as there is electric energy used to run it.

**CONTROLS:** Heat pumps operate on a single thermostat that controls both heating and cooling.

**EASE OF OPERATION:** There's nothing to it—just set the thermostat and walk away.

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**CONTROL TIPS:** You can turn down the temperature if desired, but when you increase the temperature, do so in two to four degree increments. This prohibits the back-up heating system from coming on, saving you on operating costs. If you want to "set-back" the thermostat for optimum efficiency, programmable thermostats are available.

# CALCULATING HEAT LOAD

Heating systems must be properly sized for overall comfort and efficiency. Improper sizing of a heating system can lead to lower efficiency levels and higher heating costs. Reliable heat load estimates are essential for selecting the right size and type of heating system. Properly done, the heat load estimate can save you hundreds of dollars in the cost of your heating equipment.

Heat load calculations are based on local climate conditions and the insulation levels in your home. Additional factors such as window orientation, shading, and air infiltration levels influence the heating requirements of each house. The more efficient your house, the smaller the heat requirement you will need. Your electric utility service representative can help you size the heating system for your home. Free consultation with our office can help make sure the heating equipment you choose will be adequately sized to provide maximum comfort.

## Design Heat Load Worksheet

ZONE Whole House					
Component	U-Value	x Net Area	x Temp.Difference	= Btu/Hr.	
Windows	.40	120	45	2160	
Doors	.35	40	45	630	
Doors	.39	20	45	351	
Wall	.064	932	45	2684	
Wall					
Skylights					
Ceiling	.032	1162	45	1673	
Ceiling					
Floor	.040	1162	45	2091	
Perimeter (Lin.Ft.) x F-Factor x Temp. Difference =				Btu/Hr.	
Concrete Slab					
Below-Grade Wall					
H x Volume x Ach x Temp. Difference =				Btu/Hr.	
Air Leakage	.0180	9296	.35	45	2635
Total (add all numbers in Btu/Hr. column)				12,224	
				$KW = 12,224 / 3,314 = 3.58$	
<b>Notes:</b> $3.58 \times 125\% = 4.47$ Safety Factor					

# THERMOSTATS

## CENTRAL SYSTEMS

There are two main types of thermostats for forced air systems: digital electronic and electromechanical. All thermostats are essentially an on/off switch. When it senses the room temperature has dropped below the temperature setting, it signals the furnace to provide heat until the temperature rises sufficiently.

Electromechanical thermostats depend on the expansion and contraction of a metal coil to physically move a small mercury switch that turns the furnace on or off. An electronic thermostat uses more elaborate sensors and microchips instead of the mechanical devices. Both offer a setback feature which is a good option for energy savings.

A programmable thermostat also offers energy savings since it automatically changes the temperature day-to-day based on your schedule. Digital electronic models offer more variety of temperature settings and setback periods but programming can be complex.

Electromechanical thermostats are easier to set but have fewer features and less flexibility. Quality thermostats should keep the temperature fairly constant without letting the temperature vary more than a few degrees. They should be easy to program and give options for time and temperature settings. The most versatile setback models can be programmed to allow different comfort levels and setback periods for each day of the week.

The ideal setback thermostat for a heat pump system maximizes energy savings because it plans ahead. It monitors when to start bringing the home up to a comfortable temperature and prohibits the auxiliary heating system from activating, saving on your heating costs.

## ZONAL SYSTEMS

There are two types of thermostats for zonal (baseboard, ceiling, and wall) electric heating systems: digital electronic or electromechanical thermostats with bi-metallic control sensors. Electromechanical thermostats are slow to react allowing wide temperature swings (as much as five degrees on either side of the temperature setting) before turning the heater on or off.

Electronic thermostats eliminate the wide temperature swings and provide better comfort. They act as a control center for individual zonal-heated rooms. Each room, or area, can be programmed individually and turned down as desired for maximum comfort and efficiency.

# DUCTWORK

Air leakage from ducts can drastically lower the efficiency of forced air systems. Proper sealing and installation of ductwork is extremely important. Standard "duct tape" is not an effective product to seal ductwork. Mastic sealers and foil tape with a butyl rubber backing are superior products. An air leakage test is recommended when sealing ductwork. Leaky areas can be identified and sealed properly when using this measuring device.

Duct insulation is also important. Metal ductwork should be insulated with R-11 insulation and flex duct should have a minimum of R-8. Ductwork should have gradual bends so air flow isn't restricted.

Connections between sheet metal and flex duct should be sealed with metal or nylon clamps and sealed with mastic for the mentioned above. Flex ducts should be supported with a lot of hangers and supports. Stretch the duct to its full length so air passages are as smooth as possible.

Accurate ductwork sizing and placement is critical for proper air flow. Heat pump systems require greater air flow and larger duct sizes than forced air systems. Select contractor who can properly size and install both your forced air system and the heat pump.

# INSULATION

Proper insulation levels and air sealing (caulking/weatherstripping) have a tremendous effect on the ability of the heating system to maintain a constant inside temperature at the lowest possible cost. In addition to reducing operating costs, insulation can allow you to install a smaller capacity heating unit thereby reducing your initial cost.

Make sure your home is insulated to current standards and check with your electric utility service representative to determine the proper insulation levels for your home.



## USE ENERGY WISELY!

This publication was compiled from information provided by the Northwest Regional Group, a group of electric utilities in the Northwest. For additional information contact your local utility.

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