Heating and Cooling Options

A comprehensive look at many ways to condition your home, including cost, efficiency, and environmental concerns.

Ducted/Forced-Air Systems		conditioning type	initial cost	operating cost	overall pros/cons
A forced-air system uses air as the medium to carry heat. A central mechanical unit warms or cools air, and that air travels through ductwork into the various rooms in your home.					
A heat pump is an electric appliance that captures heat from outside air and moves it indoors, or reverses that cycle and moves heat outdoors (air conditioning), dehumidifying the home in the process. The system consists of an outdoor air conditioning unit and an indoor air-handler and ductwork.	**Air-Source Heat Pump**	heating and cooling	medium	medium	◦ Provides heating, cooling, some dehumidification and air-filtration all in one ◦ Heat pumps move heat rather than making it, thus are more energy efficient than combustion ◦ Requires electricity for operation and will not function during a power outage ◦ Electricity production is usually a source of greenhouse gasses and air pollution ◦ Efficiency is greatly reduced when air-handler and ductwork are located in an attic or crawlspace ◦ Do not fuction efficiently when it is too cold outside, rely on more expensive electric backup to make heat in these conditions
Works just like an air-source heat pump except that it pulls heat from underground wells, or stores excess heat there. Because the ground stays a constant temperature year-round, these units are more efficient than any other heat pump.	**Geothermal Heat Pump**	heating and cooling	very high	very low	◦ Provides heating, cooling, and de-humidification in one system, can also provide some hot water pre-heating ◦ The most energy efficient system that provides both heating and cooling ◦ Requires electricity for operation ◦ Requires significant site disturbance to drill wells--not viable at all sites ◦ Costs significantly more than most alternatives, although generally lasts longer and provides best yearly energy savings ◦ Does not drop off in efficiency in cold climates like air-source heat pumps do, in fact this system is most cost-effective in cold climates
An appliance that burns either propane, home heating oil, or natural gas to heat air. Consists of an indoor furnace and ductwork.	**Furnace**	heating only	medium	medium (natural gas) medium (heating oil) high (propane)	◦ Cheapest system to install ◦ Does not provide cooling, dehumidification, or air-filtration--installing separate systems for those features will add cost ◦ Combustion inside the house creates indoor air quality concerns: should be vented outside and monitored for carbon monoxide ◦ Requires burning fossil fuels, a source of greenhouse gases and air pollution ◦ Some units require a "pilot light" that is constantly burning and allows the unit to function even during power outages. Others require electricity to function.
A system that uses both an air-source heat pump and a combustion furnace. Furnace comes on when it is too cold for heat pump to work efficiently, otherwise the heat pump is used.	**Dual Fuel**	heating and cooling	high	low	◦ Uses furnace when it is too cold for heat pump to work efficiently, and uses heat pump when heat pump is more efficient ◦ Provides air conditioning

Mini-Split System		conditioning type	initial cost	operating cost	overall pros/cons
A mini-split is also an air-conditioning/heat pump device, but one that uses heat exchangers and a refrigerant, rather than moving air, to transfer heat into the house. Like a heat pump this consists of an outside unit, but utilizes multiple indoor units in different sections of the house. Some of these units may be wall-mounted, ceiling mounted, or hidden and using very short duct runs to serve multiple rooms.					
A mini-split is also an air-conditioning/heat pump device, but one that uses heat exchangers and a refrigerant, rather than moving air, to transfer heat into the house. Like a heat pump this consists of an outside unit, but utilizes multiple indoor units inside different zones of the house. Although conventionally thought of as wall-mounted units, these units can be any combination of wall-mounted, floor mounted, ceiling recessed, or "short-ducted" with a small air handler hidden in a closet or dropped ceiling that runs short ducts to adjacent rooms. Often a combination of these different types of indoor air handlers creates the best match of energy efficiency and distribution in a home.	**Mini-Split Heat Pump/AC**	heating and cooling	medium	low	◦ Allow for efficient electric heating and cooling while minimizing the inefficiencies of ductwork ◦ Variable speed technology allows them to match the needed demand and operating at very, very high efficiencies ◦ Great for multi-story homes, small homes, and homes where finding space to run ductwork is challenging ◦ Can create different heating and cooling zones ◦ Do not have a built in back up. They can go down to much colder temperatures than traditional heat pumps, but a separate backup would be needed in very cold climates ◦ Not cost effective in layouts that would require many individual mini-split heads ◦ can offer better dehumidification in mixed humid than conventional heat pumps, especially in high performance homes with low air conditioning loads
Passive Solar Design		**conditioning type**	**initial cost**	**operating cost**	**overall pros/cons**
Passive Solar Design is not a mechanical system, but is a design strategy that can be paired with any mechanical system to effectively reduce both the operating cost and the required capacity--and thus installed cost--of the chosen system.					
Common passive solar design features include south-facing window glass to collect heat, dense flooring or wall materials to hold that heat, overhangs designed to shade windows when solar heat gain is not desirable, and extra insulation. Consult with Deltec's Green Department for more information on passive design for your climate.		heating, some cooling	low	NA	◦ Take advantage of free solar energy available potential available at your site ◦ Requires planning in the design stage of your project to be implemented successfully--works best when carefully thought out ◦ Approach is dictated by your local climate and site conditions ◦ Passive cooling strategies can also help reduce energy consumption
Radiant Heat		**conditioning type**	**initial cost**	**operating cost**	**overall pros/cons**
These systems use radiant heat transfer, whereby heat is delivered directly from the surface of a hot object to the people and objects in a room. Although multiple types of radiant heat are available, the most widely-used and cost-effective type is done using a hydronic radiant floor.					
A system of tubes is installed within a concrete slab or other flooring product designed for radiant heat. Hot water is pumped through these tubes, radiating heat into the home.	**Hydronic Radiant Floor Heat:**				◦ Radiating heat is more direct than moving hot air, so less of the fuel you pay for is wasted ◦ Offers greater thermal comfort than ducted systems ◦ Allows for multiple heating zones ◦ Does not provide cooling, dehumidification, or air-filtration ◦ Because concrete is slow to heat up and cool off, radiant floors do not respond quickly to controls. Works best in cold climates without large daily temperature swings
	◦with natural gas or propane boiler	heating only	high	low (natural gas) high (propane)	◦ Propane costs can fluctuate dramatically but are generally higher than other fuels, while natural gas is cheaper but not available in all areas ◦ Requires the burning of fossil fuels
Solar hot water collectors can provide the hot water for a radiant floor system.	**◦with solar hot water**	heating only	very high	very low	◦ Produce hot water from free solar energy available on site ◦ Typically designed for solar to produce 1/3 of required heat, requires a fossil fuel boiler to supplement

					◦ solar collectors add significant cost to the system ◦ Requires south-facing roof or yard space with minimal shading
A geothermal heat pump can be set up to provide hot water for radiant floor heat, rather than warm air for forced-air heat.	◦**with geothermal heat pump**	heating and cooling	very high	very low	◦ Can be matched with a ducted geothermal system to provide cooling. See pros and cons of geothermal system in ducted systems section.
Solid Fuel			initial cost	operating cost	overall pros/cons
Stoves, fireplaces, etc. that burn a wood or biomass product. These systems are often installed for ambiance or as a backup or secondary heating source, although they can be sized as a sole heating source for a small to medium home. IMPORTANT NOTE: In high performance homes, these devices MUST have dedicated outside combustion air, even wood stoves. Otherwise the risk of back drafting is too high in homes that are by design very air-tight.					
This is wood-fueled device located outside the home, that provides warm air for ducts or hot water for a circulating radiant heat system.	**Wood-Fired Furnace**	heating only	medium		◦ Runs on a renewable fuel source and is designed as a whole-house heating system ◦ Burns fuel outside, avoiding indoor air pollution problems ◦ Must be regularly supplied and maintained
A wood stove is more enclosed than a fireplace and uses a small flue shaft instead of a chimney. These stoves burn hotter and more completely than a fireplace, allowing a device that provides efficient warmth to a room.	**Wood Stove**	heating only	medium	very low* **however, generally a supplemental system only.*	◦ Can provide secondary, room-specific heat. A good whole-house backup for passive solar ◦ Uses a renewable fuel ◦ Must be vented outside: can cause indoor buildup of fine particulates ◦ particulates and smoke lead to build-up of creosote in flue, flue should be cleaned regularly to avoid a fire
A pellet stove is similar to a wood stove, except it burns concentrated pellets of wood and organic matter instead of firewood, and contains a fan and some ductwork to spread heated air into a room.	**Pellet Stove**	heating only	medium	medium	◦ Similar features to wood stove, but burns hotter for slightly greater efficiencies and requires less regular flue cleaning ◦ uses a renewable fuel--but one that is not available in all areas and often must be bought in bulk ◦ requires electricity to operate the fan