Thirty years ago, mobile phones were too clunky to fit in anybody’s pocket. VCRs recorded our favorite TV shows. Windows 1.0 was introduced. And heat pumps were the state-of-the-art option for home HVAC systems.

Times change, and technology advances have improved the conveniences we rely on, including the devices that heat and cool our homes. Today’s heating, ventilation and air conditioning systems offer new ways to increase comfort and efficiency and may even save you some money in the long run. Plus, federal tax incentives and local rebates make now an opportune time to take a new look at heat pumps.

**Heat pumps 101**

Understanding heat pumps starts with a simple fact: They don’t create heat. What they can do, in cold or hot weather, is move heat from one place to another.

This transfer process uses two possible heat sources: air or ground (or groundwater). Air-source heat pumps collect heat from the air and move it where you want it (indoors in winter, outdoors in summer). Ground-source
and water-source heat pumps are geothermal systems—they transfer heat through looped tubing or pipes located in soil or water below ground, where temperatures tend to be more stable year-round.

More than half of the homes served by S.C. electric cooperatives are heated and cooled by heat pumps, and the vast majority of those are air-source heat pumps.

“The reason heat pumps typically work for South Carolina is that we have a mild climate,” says Michael Smith, director of corporate strategy and emerging technologies for Central Electric Power Cooperative. On those rare days that S.C. air temperatures hover in the teens or 20s, heat pumps won’t deliver heat as efficiently. “But the other 360 days of the year, heat pumps are a highly efficient method of heating and cooling,” Smith says.

To keep you cool in summer and warm in winter, heat pumps rely on a system of refrigerant, coils, compressors, condensers, evaporators, air blowers and ductwork. By simply reversing the direction of the refrigerant flow when the seasons change, this system moves heat into or out of your home.

Here’s what happens: You set your thermostat to a desired indoor temperature, and the compressor kicks on to deliver that temperature. In cooling mode, the system pulls in indoor air, runs it over coils filled with cold refrigerant and blows the cooled air throughout the house. Indoor heat is collected and transferred into outdoor coils, where the refrigerant disperses that heat outside, with help from a fan.

“In summertime, that coil on the inside is absorbing heat like a sponge, and the outside coil is like a bucket dumping heat,” says Rob Shealy of Palmetto Breeze Heating and Air Conditioning in North.

For heating, the process simply works in reverse—the heat pump heats your home by taking in outside air, using refrigerant-filled coils to extract the heat and carry it indoors, where the warmer air is distributed through vents in your home.

As outside temperatures drop, heat pumps lose some efficiency, because there is less heat to draw from the air. When lows dip into the 30s, the heat pump must call on a back-up heating source. In S.C. homes, this is often electric-resistance heating coils (similar to what you’d find in a toaster), sometimes referred to as heat strips. Generating all your heat this way is less efficient and more expensive.

Most days, heat pumps are very efficient, delivering as much as three times more heat energy than the electricity they consume to operate. Today’s heat pumps are up to twice as efficient as their forerunners from the 1980s, with better refrigerant flow, quieter fans, warmer air delivery and other technical improvements, according to the U.S. Department of Energy.

**When to consider a new heat pump**

Sooner or later, every homeowner faces decisions about repairing or replacing an HVAC system. Finding answers starts with assessing your home’s unique needs.

**Think about the whole house.** “Don’t look at just the heat pump,” says David Brown, vice president of Bruce Brown Heating and Air in Andrews. If the house feels too hot or too cool, make sure the attic is well insulated, the ductwork is well sealed, and air leaks around doors and windows are caulked. “Approach the whole house as a system,” Brown says. “That plays such a big part in how the heat pump will perform.”
**Watch for increases in energy bills and equipment repairs.** Think about upgrading if your electric bill spikes up or if your heat pump needs frequent repairs for malfunctioning parts, runs on its heat strip all winter, or leaks air from the ducts. “That’s when you have high bills, and that’s where you see a lot of savings if you replace the unit,” says Eddie Plowden, director of marketing and energy services for Berkeley Electric Cooperative.

**Newer may mean more efficient.** Even if you’re not making major repairs, aging systems tend to lose efficiency over time, Shealy says, adding to your monthly bill. A rule of thumb is that if your HVAC equipment is more than 10 years old, a new system will provide greater energy efficiency, especially units with an Energy Star rating.

**Make room in your budget.** Expect to pay $4,000 to $6,000 for a quality air-source heat pump that meets the current minimum SEER rating of 14. A geothermal heat pump installation can cost $15,000 to $20,000 or more. The good news: You’ll see a return on the investment in the form of lower utility bills.

**Look for incentives.** Rebates, loans and tax credits may be available from federal, state and local sources. Visit dsireusa.org, an online database that allows users to search for current financial incentives.

**Plan now to buy later.** Research heat pump options before your system breaks down during a heat wave or winter storm. “Make a change in a planned manner, instead of when it’s an emergency,” Plowden says.

### Heating and cooling from the ground up

If you’re looking into heat pump options, you may have heard about ground-source, or geothermal, heat pumps.

Geothermal technology isn’t new—it’s been used for decades. Although less than 1 percent of S.C. homes use geothermal heat pumps for heating and cooling, they are gaining attention, thanks to their high efficiency, quiet operation, durability and low-impact maintenance.

Geothermal heat pumps operate on the same heat-transfer principles seen in air-source heat pumps, but they use 25 to 50 percent less electricity than conventional HVAC systems, according to the South Carolina Energy Office.

Unlike the fluctuating outdoor air temperatures that impact the performance of air-source heat pumps, underground temperatures stay fairly constant, around 67 F, allowing a ground-source heat pump to transfer heat more efficiently. That heat exchange can be two or three times more efficient than air-source systems on the coldest days, according to the DOE.

Geothermal systems aren’t for everybody. The upfront costs of materials and installation are significantly higher than for conventional systems, although homeowners can expect to recoup those costs in two to 10 years, saving 30 to 60 percent on monthly heating and cooling bills. The home’s location is also a consideration—for ground-source or water-source heat pumps, the surrounding land space, soil type and available water sources factor into the feasibility of installation.
“Ground loop” is the term used to describe the system of sealed, underground pipes, filled with water or refrigerant, that transfers heat between your home and an outdoor medium—the ground outside, or a nearby water source, such as a well or pond. The pipes may be installed horizontally or vertically, depending on the site.

The average cost of replacing a conventional home HVAC system with a geothermal heat pump—depending on factors such as soil type or water sources used—can run from $15,000 to $20,000 or more, says David Brown of Bruce Brown Heating and Air. Retrofits can use existing ductwork.

Among the benefits of geothermal heat pumps is their long life—inside system components are estimated to last 25 years, and most underground components carry a 50-year warranty. Underground repairs are rare but may be costly. Regular maintenance involves periodic system checks and filter changes, but with indoor components protected from the elements, fewer problems are likely, and average maintenance costs are about a third of the average for conventional systems, according to the S.C. Energy Office.

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**Get a geothermal tax break**

If you’re tempted to install a geothermal heat pump system, do it before the end of 2016 to save some money. Homeowners can claim a federal tax credit of 30 percent on materials and installation of geothermal heat pumps that meet Energy Star criteria and are placed in service by Dec. 31, 2016. Both new and existing homes are eligible, as long as they are owned and used by the taxpayer. Rentals are not eligible. For details, visit [energy.gov/savings](http://energy.gov/savings).

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**A shopper’s guide to heat pumps**

Before jumping into the market for a new heat pump, arm yourself with some terminology and a game plan.

**Get to know efficiency ratings.** Abbreviations like SEER, EER and HSPF show up when you start comparing one heat pump to another. They indicate a unit’s heating or cooling efficiency. Higher numbers mean more efficiency and lower operating costs, but those units may be more expensive up front.

- **SEER (Seasonal Energy Efficiency Ratio):** This rates an air-source heat pump’s cooling efficiency. Look for air-source heat pumps with a SEER between 14 and 18, and consider the return on your investment for units with higher SEER numbers and higher costs, Shealy advises. “You can spend as much as you want,” he says, “but can you practically get that money back over the life of the system?”

- **HSPF (Heating Seasonal Performance Factor):** This indicates an air-source heat pump’s heating efficiency. An efficient HSPF range is 8.2 to 11.

- **EER (Energy Efficiency Ratio):** This measure is used to rate cooling effectiveness for geothermal heat pumps. Similar to SEER, it reflects a ratio of total cooling capacity to energy used. High-efficiency systems can be rated 18 and up.

- **COP (Coefficient of Performance):** Another guide used for geothermal systems, the COP measures efficiency in the heating mode. For high-efficiency models, COP may range between 3.6 and 5.4.
Be thinking about special features. If your budget allows, consider these options:

- **Two-stage compressors** allow your heat pump to run more efficiently—at an energy-saving lower capacity for most needs, kicking into a second stage only when you need more cooling or heating power. They’re great for lowering your winter heating bill, according to Eddie Plowden, director of marketing and energy services for Berkeley Electric Cooperative.

- **Scroll compressors** are replacing the traditional reciprocating, or piston, compressors, offering quieter, more efficient and longer-lasting operation than their forerunners.

- **Variable-speed motors**, available on some models, allow fans (or air blowers) to move air at desired levels. These can minimize noise while the unit is running.

- **Desuperheaters** are options that allow your geothermal heat pump to provide heat to your home’s electric water heater as well.

- **Dual-fuel systems** offer an efficient alternative to the electric-resistance heat strips that kick in when very cold temperatures challenge a heat pump’s ability to maintain heat. They use a combustion source, such as propane or natural gas, to create heat. “This is the perfect mix for someone who’s been a big fan of gas over the years,” Shealy says. It combines the warm feel of gas heat on the coldest days with the cost savings of heat-pump efficiency the rest of the year.

Hire a qualified professional. A reputable, licensed HVAC contractor can advise you on the right heat pump for your needs, keeping your budget in mind. He should perform a heat-load calculation to ensure you have the right-size unit and duct system for your home. A proper heat-load calculation will evaluate your home’s square footage, building materials, location, insulation, number of stories, room sizes and desired home temperature.

If it’s geothermal you want, call on a contractor who is accredited and experienced in these specialized installations ([www.igshpa.okstate.edu/](http://www.igshpa.okstate.edu/) maintains a directory of geothermal professionals). He will also be able to advise whether you have the land space, soil type and water resources needed for a geothermal heat pump installation.

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**When to go ductless**

Mini-split, or ductless, heat pumps are systems that can cool or heat individual rooms. They can be used throughout a house or in a single room.

A mini-split operates much like an air-source heat pump, but since it doesn’t require a network of ducts, it’s an attractive option for room additions and in homes without ductwork or without space for ductwork. It’s also an efficient means of heating or cooling rooms that tend to stay colder or hotter than the rest of the house. Mini-splits also allow for zone cooling and heating, which can save electricity—run the units only in rooms you use, with no need to heat or cool unused spaces.

The mini-split has both indoor and outdoor components. A small, flat outdoor unit, consisting of condenser fan, coils and compressor, is often mounted on an exterior wall, keeping the noisier components outside. Inside, one or more small fan units are mounted high on a wall or ceiling in the rooms where they are needed.
Innovative inverter compressor technology in some mini-split systems lets the compressor run at variable speeds—when a room reaches your selected thermostat setting, the inverter compressor speed slows to maintain that temperature. Newer models also offer options for remote control and a dehumidification setting.

Mini-splits can be costly—equipment plus installation can run several thousand dollars. But in homes that rely on electric-resistance heating methods or where aging ductwork may be losing its efficiency, they can help reduce monthly electric bills, according to the NRECA Cooperative Research Network. An HVAC professional can help you decide if a mini-split is suited to your needs.

Get the most out of your heat pump

- Change air filters monthly—good air flow is essential for the system to run efficiently. “When you get your light bill, change your filter,” David Brown, vice president of Bruce Brown Heating and Air in Andrews, recommends. The inexpensive fiberglass filters you find at discount department stores will do the job.
- Annual professional maintenance helps maximize the life of a heat pump system. A certified HVAC technician will check electrical connections and refrigerant levels, inspect for duct leaks, ensure all parts of the unit are functioning correctly, and make needed adjustments. A neglected heat pump can consume up to 25 percent more energy than a well-maintained unit, according to the DOE.
- Don’t flip over to the emergency heat setting—unless you have a real emergency. On the “heat” setting, a heat pump will automatically use supplemental or auxiliary heating (usually heat strips) to help reach the thermostat setting on the coldest days. It’s less energy efficient and more costly, but it helps the heat pump in short bursts. Switching over to the “emergency heat” locks out the regular heat pump operation, says Rob Shealy of Palmetto Breeze Heating and Air Conditioning in North. This makes your system run on those heat strips all the time—wasting energy and dollars. Manually switch to “emergency heat” only if the heat pump stops working, just so you’ll have heat until a technician can repair the unit.