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Energy Efficient Homes: Air Conditioning[1]

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Quick Facts

- Heating, ventilation and air conditioning accounts for more than 40% of your utility bill.
- For every degree setting below 78°F, you spend up to 8% more in cooling costs.
- The average cost of electricity in Florida in 2007 was $0.11/kWh.
- Upgrading from a 9-SEER to a 13-SEER system can reduce your air conditioning costs by over 30%.

Terms to Help Get You Started

- **Ton** A measurement of size used to determine cooling capacity
- **HVAC** Heating, Ventilation, and Air Conditioning equipment
- **BTU & kWh** British Thermal Unit & kilowatt-hours
- **SEER** A measure of efficiency for air conditioning units; the higher the SEER number, the more energy efficient the unit is in cooling the air
- **SHR** A measure of efficiency for air conditioning systems ability to remove moisture or humidity; the higher the SHR number, the less capable the system is in removing humidity
- **Air handler** The indoor unit that moves the air through the heating/cooling system
- **Cooling load & Load calculation** Measurements that calculate what size system is appropriate for a particular structure given its square footage, ductwork analysis, insulation, windows, etc.
- **Condenser** The outdoor unit that keeps the refrigerant cool
- **Heat Pump** An air conditioner equipped with a valve that lets it “switch” between “cooling mode” and “heating mode"

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- **Supply & Return** Supply registers and ducts bring conditioned air in; return registers and ducts draw air out to be reconditioned

Why should I be concerned about the efficiency of my air conditioning?

The largest consumer of energy in the typical Florida home is the heating, ventilation and air conditioning (HVAC) system which can account for more than 40% of home energy use and therefore for more than 40% of your utility bill. Energy use by your HVAC system is affected by many factors such as insulation levels, system efficiency, shading on the home, quality and sealing of the windows and doors, integrity of the duct system, and, of course, how it is used.

Because of the heat and humidity, most Florida residents today rely on air conditioning systems to maintain not only reasonable comfort levels, but lower humidity levels as well. The size, efficiency, and placement of an air conditioning system, therefore, are all important. Equally critical is the air conditioning contractor selected, particularly because the operating efficiency of a system relies on proper installation to achieve its performance rating. A skilled air conditioning contractor's keys to obtaining the designed efficiency of a system in the field include: proper sizing of the system for the specific cooling load of the home; selection and proper installation of thermostats or controls; proper installation and commissioning of the system; a duct system designed to deliver the correct amount of conditioned air to each space within the building; and sealing and insulating all ductwork.

Isn't bigger better?

Sizing the air conditioner close to the actual load (cooling requirement) provides better humidity control and typically results in energy savings when compared to an oversized air conditioner with the same performance characteristics. Better humidity control results from a higher percentage of run time during which the coil is operating at its coldest temperature allowing more condensate to form and flow out of the system, while energy savings result from less start and stop operation and higher comfort levels due to better humidity control. Reducing the number of cycles may also result in longer equipment life. However, close-sizing also comes with requirements. Since there should not be large excess capacity on the hottest days, the system must be properly maintained—most importantly, keep it clean. Also, energy efficient features of the house that reduce air conditioning load such as proper sealing of ductwork and connections, windows, insulation and sealing against infiltration must actually be done and done correctly.

Over-sizing generally results in higher equipment costs, but will allow faster cool downs and can overcome (from a room temperature standpoint) some issues such as leaking ductwork, poor AC maintenance, ductwork poorly insulated, insulation improperly installed or missing, and excessive infiltration (uncontrolled outdoor air coming inside the home). In the long run, over-sizing is just not recommended—a properly sized system and efficient components will bring more benefits to you and your home.

To assure proper sizing, the load must be calculated—not just estimated based on square feet. Load calculations are based on the exact area, orientation, and type of construction for each component of the building envelope, as well as the heat given off by the lights, people, and equipment inside the building, etc. The standard for residential air conditioning sizing is *ACCA Manual J* or a method based upon *Manual J*. (ACCA stands for Air Conditioning Contractors of America [http://www.acca.org]).

Make sure your contractor conducts comprehensive load calculations before accepting a bid. Central air conditioner and heat pump capacity is generally referred to in terms of tons. A ton of air conditioning is equal to 12,000 BTU per hour.

What exactly is SEER?

The cooling efficiency of a heat pump or an air conditioning system is rated by the Seasonal Energy Efficiency Ratio (SEER). The SEER is defined as a ratio of the average amount of cooling per unit of electricity used. Federal regulation mandates a minimum SEER 13.0 for most residential air

conditioners manufactured after January 23, 2006. Efficiencies of some systems can be as high as SEER 17.0 or more. (Chances are that older homes have units with SEERs less than 10.) Note that it is important to understand that even though the SEER may be high, if the system is inefficient (for example, leaky ductwork), you will not receive the full value of the efficiency as the air distribution system is not used to determine the SEER rating.

So a high SEER system will also take care of the humidity in my house, right?

Not necessarily. You also need to consider the Sensible Heat Ratio (SHR) which describes the moisture-removal capability of air conditioning systems. A SHR on HVAC equipment of 0.7 means that 70% of the air conditioning unit's load is devoted to cooling, and 30% to removing humidity. It is critical that the HVAC contractor accurately estimate the humidity load (also referred to as latent load).

Outdoor air, coming in through poorly sealed windows and doors, open fireplace dampers, and bath and kitchen vents, causes most of the moisture load in your home. Even the simple act of opening and closing exterior doors adds humidity to your home. In addition, plants, bathing, cooking, cleaning, combustion, standing water in commodes and drains, and even breathing add to indoor humidity.

Note that many high SEER units have poorer humidity removal capacity, so verify the SHR before purchasing and ask the HVAC contractor to provide written confirmation. Keep in mind that with air conditioners, which operate based on room temperature, humidity is not controlled directly, and any humidity control is a by-product of temperature control.

How does it all add up?

This is where it gets a bit complex. The SEER, the SHR, and the system tonnage must be in balance so difficulties don't occur with indoor air quality. Systems without an adequate SHR, or with inaccurate tonnage, cool without removing moisture. An over-sized air conditioner will cool your home too quickly to remove moisture very effectively.

This results in a home that is cool, but "clammy." If systems are not providing sufficient dehumidification, the typical owner response is to lower the thermostat setting. Since every degree the thermostat is lowered actually increases cooling bills up to 8%, systems that have nominally high efficiencies but inadequate dehumidification may suffer from higher than expected cooling bills.

What are some short-term solutions to improve the efficiency of my existing system?

The US Department of Energy suggests the following:

- Set your thermostat at 78°F or higher.
- Use bath and kitchen fans sparingly when the air conditioner is operating.
- Inspect and clean both the indoor and outdoor coils. The indoor coil in your air conditioner acts as a magnet for dust because it is constantly wetted during the cooling season. Dirt build-up on the indoor coil is the single most common cause of poor efficiency. The outdoor coil must also be checked periodically for dirt build-up and cleaned if necessary.
- Check the refrigerant charge. The circulating fluid in your air conditioner is a special refrigerant gas that is put in when the system is installed. If the system is overcharged or undercharged with refrigerant, it will not work properly. You will need a service contractor to check the fluid and adjust it appropriately.
- Reduce the cooling load by using cost-effective conservation measures. For example, effectively shade east and west windows. When possible, delay heat-generating activities, such as dishwashing, until the evening on hot days.
- Over most of the cooling season, keep the house closed tight during the day. Don't let in unwanted heat and humidity.
- Try not to use a dehumidifier at the same time your air conditioner is operating. The dehumidifier will increase the cooling load and force the air conditioner to work harder.

In addition:

- Consider installing ceiling fans to circulate the air more effectively. The improved circulation will make you feel cooler.

- Install a programmable thermostat, too. Using a programmable thermostat, you can schedule the time blocks during which your heating or air-conditioning system operates. As a result, you can set the equipment to more economical settings—such as lower temperatures in winter while you are asleep or when you are away from home. Choose one that can store and repeat multiple daily settings, so that you can have both a workday and a weekend heating/cooling time table. A manual override feature is a great convenience, allowing you to override current settings without affecting the rest of the program. Look for the ENERGY STAR® label before purchasing and make certain the thermostat is designed to operate with your system.

When I'm ready to invest in a new air conditioning system, what should I keep in mind for the long-term?

AC component locations

Central HVAC systems have a component called an air handling unit or AHU (often referred to simply as the "air handler"). If you have the option, choose a conditioned space for placement of the air handler. The advantages of placing the AHU in conditioned space include: it is in a more favorable environment; a central location can minimize duct lengths and optimize air flow; there is easier access for maintenance; and any leaks occur in conditioned space.

Another often ill-considered area of installation concerns the placement of the outside unit (condenser). Manufacturers recommendations for proper clearance distances should be followed to the letter to ensure there is no blockage of air flow from the unit. Also, do not vent a clothes dryer within 10 feet of the outdoor unit as dryer lint will cling to the condensing coil, lowering both the system's efficiency, and its service life.

Keep in mind that the major components of the system, such as the air handling unit and the condenser, are joined together for the first time at your home. The efficiency and reliability of the entire system is directly related to the care and quality of the work that goes into the planning and installation of the complete system – including the thermostat and duct system.

Questions the HVAC contractor should ask *you*

The HVAC contractor should ask you the following questions to help properly conduct a comfort analysis and system design for your family and home:

- Would you like to change anything about your current air conditioning and/or heating system?

- What do you like most about your present system?

- What benefits do you expect from your new system?

- Does your existing system heat and cool your home to your satisfaction?

- Are there rooms that are too hot or too cold?

- What temperature is your thermostat set on during the summer? Winter?

- Do you have a scheduled lifestyle that encourages adjusting the thermostat frequently, or for stretches of time for which you know the home will not be occupied?

- Do you set the thermostat at different temperatures for the hours that you're awake and the hours you're asleep?

- What types of heating or cooling problems have you experienced?

- Have you had any problems with condensate drainage?

- What is your average summer electric bill?

- Who performs your regular energy-savings check-ups?
- How long do you plan on residing in this home?
- Do you plan to remodel or expand your floor plan in the future?
- Have you made any changes to your home since the existing air conditioning and/or heating system was originally installed?
- How many people reside in your home?
- Does anyone residing in your home have allergies?
- Do you understand ratings like SEER and SHR?
- Do you understand how HVAC systems work or, more specifically, do you understand how the system I'm recommending for your home works?

You should also realize that many of the same questions listed above should be asked when determining what HVAC system should go in a new home as the building plans are being drawn. In addition:

- **Be sure your contractor is licensed, well trained, and experienced.** Ask to see a valid contractor's license (in Florida you can check to see if they are licensed by referring to the web site http://www.myfloridalicense.com/dbpr/index.html - click on "Verify a License," then conduct your search), proof of coverage for workers compensation, and certificate of insurance coverage for liability and property damage. (Note: For definitions/descriptions of the different kinds of licenses, visit the *MyFloridaLicense* web site at http://www.myfloridalicense.com/dbpr/pro/cilb/codes.) Ask for proof that your contractor is certified to handle refrigerant in cooling systems. Also, inquire about references and membership in contractor associations.
- **Request a calculation of your savings.** Heating and cooling equipment comes with three price tags: the cost to buy the equipment, the cost to repair and maintain, and the cost to operate. Your contractor should be able to calculate your utility bill savings and total lifetime costs.
- **Request a load calculation.** Ask your contractor to calculate equipment size using computer software or professional guidelines. This will require taking measurements in your house and asking questions. Don't use a contractor who wants to size your system solely on the square footage of your house.
- **Inspect ducts.** Ask your contractor to inspect your ducts for leaks, incomplete connections, and compatibility with the rest of your system. Evaluate your system's performance. Ideally, your contractor should use diagnostic equipment, and, if necessary, fix leaks using a UL-rated quality duct sealant. In some cases, proper duct repairs may include actual duct modifications to ensure proper supply and return airflow.
- **Consider a house pressurization test.** If you have any kind of fuel burning equipment (gas, wood, kerosene, propane, oil) in your home, test your house and appliances for "back drafting." Back drafting occurs when the fumes from the combustion process are pulled back into the home, threatening the health and safety of occupants.
- **Replace both indoor and outdoor units.** If you're replacing an air conditioner or heat pump, be sure to replace both indoor and outdoor units for maximum efficiency and reliability if the units do not match in age, refrigerant, or efficiency.
- **Obtain a written contract.** Always obtain a written contract or proposal before allowing your contractor to install a new system. Be sure to ask about warranties for labor and parts.
- **Weigh the costs.** Remember that the lowest price may not always be the best price. Carefully evaluate a contractor's proposal to ensure you get the equipment and service that best meets your needs. Paying slightly more now may get you better equipment and service, and save you money in the years to come due to lower costs of ownership.

- **Install for easy maintenance.** Make sure the inside coil can be reached for its annual cleaning. The air filter(s) should also be accessible for easy removal so that it/they may be cleaned or changed when dirty. Check filter(s) monthly during peak season.

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