

## ENERGY-EFFICIENT HVAC EQUIPMENT

The heating, ventilating and air-conditioning (HVAC) system has a major influence on the comfort and quality of a building's indoor environment. The HVAC system also accounts for 30 to 50 percent of a commercial business's annual electric bill. The chart below shows an estimate of the cost to maintain comfort in various types of businesses.<sup>1</sup> When constructing a new building or renovating an existing one, this fact sheet can show how to take advantage of HVAC technology to reduce the cost of heating and cooling the space efficiently and economically.

### Sources of Summer Heat Gain in Commercial Buildings

To improve a building's overall cooling efficiency, it is helpful to understand what sources of heat gain create the greatest cooling load on the air conditioning system. By reducing those loads, air conditioning energy costs can be lowered and comfort often can be improved. The following chart shows the sources of heat gain for a commercial office building in the Phoenix area.

### Annual Heating, Cooling and Ventilating Electricity Costs

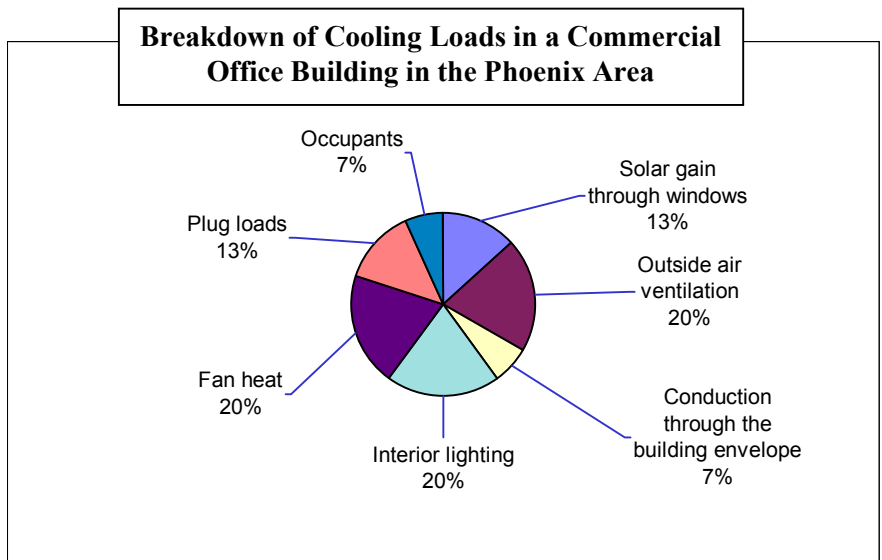
Building Type	Annual Cost Per Square Foot
Large Office	\$0.70
Small Office	\$0.50
Large Retail	\$0.50
Small Retail	\$0.25
Sit-down Restaurant	\$1.10
Quick-service Restaurant	\$2.45
Large Grocery	\$0.65
Small Grocery	\$1.70
In-patient Healthcare	\$0.95
Out-patient Healthcare	\$0.70
Primary School	\$0.35
Secondary School	\$0.45
College/University	\$0.60
Hotel/Resort	\$0.80

### Different Types of Air Conditioning Systems

This fact sheet focuses on air conditioning equipment and related system considerations for small to mid-sized commercial facilities. Several of the most common systems are discussed below.

**Unitary heat pumps and air conditioners.** The most common types of air conditioning equipment are unitary air conditioners and heat pumps. "Unitary" refers to the fact that all of the components necessary to heat, cool, dehumidify, filter and move air are included in one or more factory-made assemblies. Unitary equipment is available as single package or as split systems. Single package units include all of the necessary functions and components in one package that is installed outside the building. Split systems are made up of an indoor unit (fan and cooling/heating coils) and an outdoor unit

**Breakdown of Cooling Loads in a Commercial Office Building in the Phoenix Area**



<sup>1</sup> APS study of energy use in 14 different types of commercial buildings in the Phoenix area.

(condenser and compressor). Unitary equipment includes heat pumps and air conditioners with integral or separate gas or electric heating systems. Heat pumps provide both heating and cooling from the same unit and are the most efficient devices for low desert areas of Arizona. Air conditioners provide cooling only and must be supplemented with either an internal electric or gas-heating coil or with a totally stand-alone heating system.

**Evaporative cooling systems.** Evaporative coolers provide cooling by blowing hot, dry air over a wetted pad and cooling the hot air by the process of evaporation. In doing so, the humidity of the air entering the conditioned space is increased. The most common form of this technology is *direct* evaporative cooling otherwise known as a “swamp cooler.” Another form is *indirect* evaporative cooling that eliminates the problem of increasing the humidity level of the air by using a heat exchanger. *Indirect/direct* systems that combine these two approaches to improve effectiveness while limiting humidity are also available. Due to Arizona’s arid climate, evaporative cooling can be a viable low-cost technology in many commercial applications. Direct systems use 60 to 80 percent less energy than a heat pump or air conditioner.<sup>2</sup>

**The air conditioning system.** An air conditioning system includes more than just the air conditioning unit itself. A complete system also includes the air distribution system (ductwork, dampers, grilles and registers), and the temperature and schedule control system. Each of these components makes an important contribution to the performance and efficiency of the system as a whole. In order to operate efficiently, a system needs to be properly sized and installed. Oversized units cost more to operate and do a poor job of comfort control, and poor installation can dramatically reduce the as-installed efficiency of the system (see the chart below for a presentation of as-installed efficiencies). A quality installation will have properly sized ductwork that is sealed with mastic to reduce air leakage to a minimum, balanced airflow throughout the building, and proper refrigerant charge and airflow. The controls are also an integral part of the system and should include programmable thermostats and timers for scheduling of air conditioning equipment or a computerized energy management systems (EMS).

### Understanding Heating and Cooling Equipment Performance Ratings

**SEER** – The Seasonal Energy Efficiency Ratio is a representation of the cooling season efficiency of a heat pump or air conditioner in cooler climates. It applies to units of less than 65,000 Btuh capacity

**EER** – The Energy Efficiency Ratio is a measure of a unit’s efficiency at full load conditions and 95 degrees outdoor temperatures. It typically applies to larger units over 65,000 Btuh capacity.

**HSPF** – The Heating Season Performance Factor is a representation of the heating efficiency of a heat pump in cooler climates.

**COP** – Coefficient of Performance is the measure of heating efficiency of a heat pump at a constant temperature of 47 degrees.

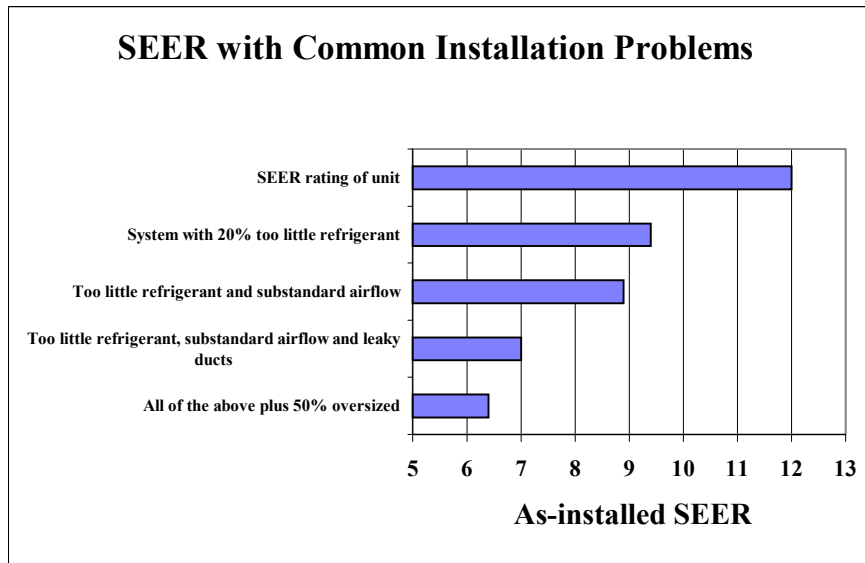
**Btuh** – Btuh or Btu/h is a rate of heating or cooling expressed in terms of British Thermal Units per Hour.

**Ton** – One ton of cooling is the energy required to melt one ton of ice in one hour. One ton = 12,000 Btuh

## Efficiency Ratings of HVAC Equipment

Federal law mandates a minimum efficiency of 10 SEER for unitary equipment of less than 65,000 Btuh capacity. The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) recommends 10 EER for equipment between 65,000 and 135,000 Btuh. ASHRAE standard 90.1 recommends other efficiencies for larger equipment. It is often cost effective to pay for more efficient equipment. For example, upgrading from a 10 SEER to a 12 will reduce cooling costs by about 15 percent. Upgrading from a 10 to a 15 reduces cooling costs by about 30 percent.

<sup>2</sup> Commercial Space Cooling and Air Handling, E Source, 1997.



## Saving Money on Your Heating and Cooling Bill

There are many cost-effective ways to save on your heating and cooling energy bill. Several measures are presented below and the chart provides estimates of annual energy cost savings. Refer to our fact sheets on windows and other building construction technologies for additional guidance on ways to reduce the costs of heating and cooling your building.

### 1. High efficiency heating and cooling equipment

- Units with a high SEER or EER rating.
- High-efficient units have features such as thermal expansion valves, multi-stage compressors, high-efficiency fan motors, and variable speed fans.

### 2. Proper installation of HVAC systems

- Properly sized heating and cooling equipment. Oversized equipment is much less efficient and does a poorer job of maintaining comfort.
- Properly sized ducts that are insulated and sealed with mastic for minimal air leakage. Make sure the airflow in the building is balanced to design specifications.
- Equipment checked for proper airflow and refrigerant charge per manufacturers' recommendations.
- Avoid using building cavities for return air passages. The cavity is under negative air pressure when used as a return air passage. The negative pressure will draw air into the building through any leaks in the envelope. Indications are that this may significantly reduce the performance of HVAC systems.

### 3. Install an economizer

- Cool the building with outdoor air when temperatures are mild.

### 4. Reduce cooling load

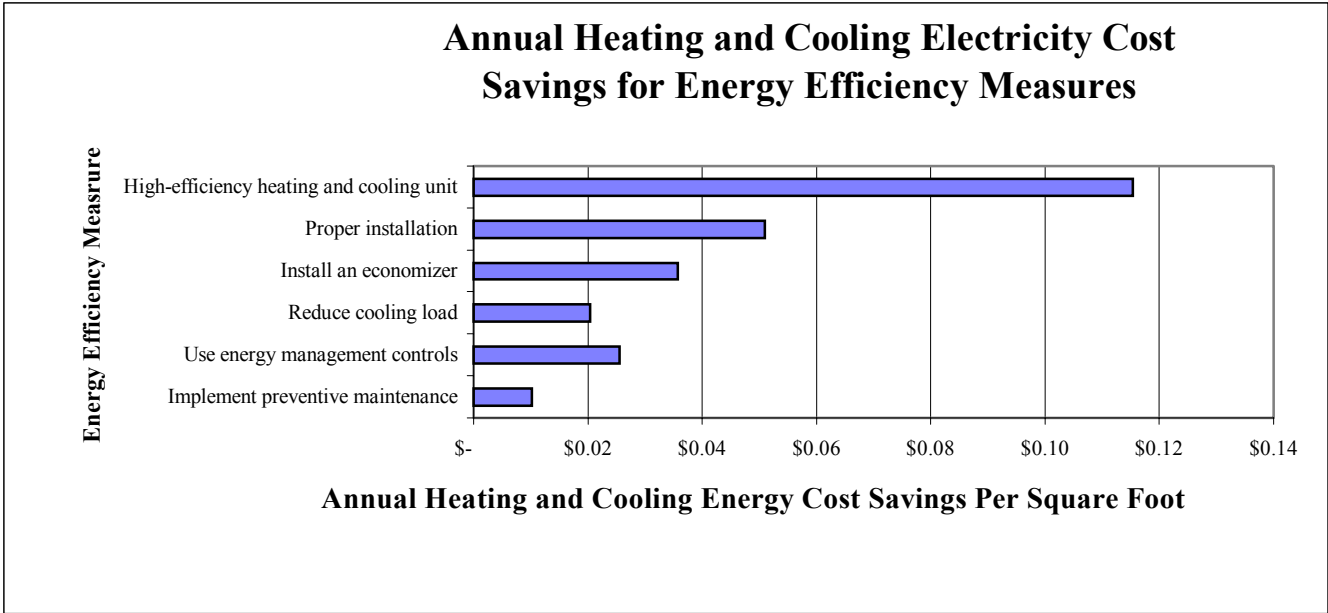
- Insulate ceilings and attics.
- Install low-e windows, or internal or external window shades.
- Use energy-efficient lighting to reduce internal heat gain.
- Turn off office equipment evenings and weekends.

### 5. Use energy management controls

- Programmable thermostats.
- Programmable time clocks, or computerized energy management systems (EMS) for more sophisticated controls.

### 6. Preventive maintenance

- Change filters every month or more often if conditions dictate.
- Check annually for refrigerant charge, loose electrical connections and dirt buildup on coils.



### For More Information on Energy-efficient HVAC Systems

Contact the Web sites of the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE), the U.S. Department of Energy’s Energy Efficiency and Renewable Energy Network, and the U.S. Environmental Protection Agency’s Energy Star Buildings Program.

For general information regarding electric service for your business, call the APS Business Center at 602-371-6767 or 800-253-9407. For an online analysis of your business energy use, visit the APS Web site at [www.aps.com](http://www.aps.com) and take the Energy Survey at [http://www.aps.com/aps\\_services/energysurvey/Default\\_BUSRES.html?type=b](http://www.aps.com/aps_services/energysurvey/Default_BUSRES.html?type=b)