

# Efficient Commercial Packaged HVAC Systems

A Pacific Energy Center Factsheet



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## How This Technology Saves Energy

Packaged HVAC (Heating, Ventilation, and Air Conditioning) systems typically consist of pre-assembled, off-the-shelf equipment combining heating, cooling, and fan sections. These systems are used in almost all classes of buildings, particularly where low initial cost and simplified installation are important, and performance requirements are less demanding. The two major ways to improve their energy efficiency are: (1) increasing the efficiency of the packaged system itself, and (2) modifying how the packaged system interacts with other parts of the system, such as thermostats and outside air controls.

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## Energy Efficiency Improvements

Installing new packaged systems and replacing existing equipment both provide opportunities to achieve high energy efficiency. Here are some typical strategies for doing so:

*Select equipment with higher efficiency ratings.* The energy efficiency of a packaged system is largely determined by the certified efficiency of the equipment itself. All other things being equal, equipment with a higher efficiency rating will use less energy.

To achieve higher efficiencies, off-the-shelf equipment manufacturers have improved heat exchangers, compressor controls, fan performance and cabinet designs. Custom- or semi-custom-engineered equipment is often significantly more efficient, but costs more per unit of cooling capacity than off-the-shelf systems, whose cost may depend more on who manufactures it than on the efficiency rating.

All new packaged HVAC equipment sold in California must meet the minimum efficiency requirements of Title 20 (Appliance Efficiency Regulations) or Title 24 (Energy Efficiency Standards for Residential and Nonresidential Buildings). These Standards include requirements for efficient design and control of the whole system.

*Improve temperature and time controls.* Energy codes require packaged equipment to be controlled by programmable thermostats. Although these thermostats save energy by turning heating or cooling systems down or off when facilities are unoccupied, users can often reduce energy use still further by installing an energy management system (EMS) in lieu of individual programmable thermostats.

Particularly where units serve numerous temperature zones and working schedules, an EMS centralizes and coordinates the operation of the packaged units. This can reduce inefficiencies among the units, such as mis-programmed individual thermostats or adjacent units working against each other (one unit heating a space, another cooling the adjacent space).

*Add an economizer for free cooling.* An economizer allows outside air to be used for cooling when its temperature is lower than the temperature inside the building. Rooftop units are particularly well-suited for using this "free" cooling, and economizers are available as an option for many off-the-shelf units. California Energy Efficiency Standards require economizers on most larger new equipment. Economizers can also be retrofitted to existing packaged systems, especially ones not too old.

*Improve fan controls.* Some packaged HVAC units, known as variable air volume, or VAV, systems, control the temperatures of various zones by increasing or decreasing the amount of hot or cold air flowing into each zone. The least efficient VAV systems run their fans continuously at full speed, and recirculate unneeded conditioned air back to the fans.

More efficient than recirculation for controlling VAV systems are inlet guide vanes or similar devices to reduce the amount of air the fans must move. Most efficient is to install an adjustable speed drive (ASD) to match the speed of the fan to the amount of air needed. ASDs unfortunately are not currently available for off-the-shelf rooftop units. Manufacturers can outfit custom and semi-custom units with ASD fan controls.

*Install indirect evaporative cooling modules,* which use evaporating water to cool air. The evaporating water is discharged outside rather than being added to the conditioned air.

When these modules are installed on single-package equipment, the evaporating water cuts the work the air conditioning unit must do. Several manufacturers offer such modules.

The modules consist of a set of tubes with dry interior air passages and an exterior surface coated with a fibrous material to absorb and retain water. Water circulates over this surface while air moves over it; the evaporative cooling effect reduces the temperature of the tubes. Air to be conditioned is moved through the dry air passage, releasing its heat to the cooled surfaces, and cooling the air without adding moisture.

To improve the cooling capability of the indirect evaporative module, the system may use building exhaust air as the air source for the wet-side air passage. This air has already been conditioned and thus is typically cooler than outside air during the cooling season. This can be especially valuable for buildings that require large amounts of outside air ventilation.

## **Benefits and Pitfalls**

Efficient packaged HVAC systems can provide significant energy savings in a wide variety of uses. In some situations, however, they may not be feasible or economical. Both benefits and pitfalls of these systems should be considered before selecting them.

### *Benefits*

- High-efficiency packaged HVAC systems can use up to 40 percent less energy than systems that just meet minimum standards. Savings can be even greater when new systems are custom-engineered or replace old systems.
- If the existing system cannot meet heating or cooling demands, installing a high-efficiency unit can improve the comfort and productivity of employees or tenants.
- Particularly harsh operating locations, such as rooftops near the ocean, might require customized equipment. This would make it easier to also specify certain high-efficiency features (for example, improved fan controls).
- Economizers are especially well-suited for cooling spaces with numerous internal heat sources and direct sun exposure.
- Indirect evaporative modules work best in hot, dry climates.

### *Pitfalls*

- If the humidity in a space must be closely controlled, economizers might increase energy use in some cases.
- Both economizers and indirect evaporative modules are not usually cost effective for small units.
- Economizer controls need to be checked regularly for proper operation. If they fail, they may consume more energy than if they were never installed.
- Programmable thermostats need to be checked regularly for proper programming to ensure continued energy savings.

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## **For More Information**

Contact your PG&E representative or call 1-800-468-4743 for more information about PG&E's energy efficiency programs and other services.

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