

## Combination Water & Space Heating Systems

### Introduction

This fact sheet presents information on the installation and use of combination water and space heating systems in multifamily residential building projects. This information will be useful to building owners, developers and designers working in the multifamily field, especially those working in the area of affordable housing. Where possible information has also been included that pertains to the use of combination systems in single family housing.

Water heating in California multifamily buildings accounts for between 40 and 70 percent of building energy use. In the San Francisco Bay Area, where heating and cooling loads are moderate, the percentage is probably at the high end of this range. In the single-family housing market water heating represents about 25 percent of the annual energy use. Combining the space heating and water heating functions in a single appliance can substantially reduce the energy used for water and space heating and reduce initial construction costs by eliminating the need for a separate furnace for space heating.

Combination water and space heating systems use a high efficiency water heater or central boiler to supply heating energy to the space heating system while still meeting the needs for domestic hot water. The space-heating component can be accomplished with either a forced air system or a radiant heat system. A forced air system can either use hot water piped to individual fan coil units in each unit or the hot water can be sent to a central heat exchanger and fan coil unit that then sends hot air to the individual units. When installing a combination system in conjunction with a cooling system, the same distribution system must be used to achieve any initial cost savings. Cooling systems can use either piped water or forced air but forced air is much more common and usually less expensive.

Combination systems are very effective for use in apartment complexes and small homes but can also be effective in large homes using multiple or zoned water heating systems.

Combination systems perform most efficiently when used with a high efficiency gas water heater. Gas furnaces, water heaters and ranges are more efficient than similar electric appliances. Because gas is piped directly to the appliance and consumed on site there are no transmission and distribution losses which can be as high as 15–18 percent in moving electricity from power plants to end users. The most efficient fossil fuel power plants now operate at efficiencies of about 55 percent and may be as low as 35 percent on older power plants. Very High efficiency gas water heaters that are made for combo systems and efficient central boilers can operate at efficiencies of 90 percent or higher, making gas much more efficient and cost effective than electricity for space and water heating.

### Green Building Benefits

The most important benefit of combination systems will be the energy efficiency and the resulting reduction in air pollution. A highly efficient combination system can reduce water heating and space heating energy use by 15 percent or more compared to a standard water heater and space heating installation. This reduction in energy use and operating costs leads to higher profits or lower rents on multifamily projects.

Using a combination system reduces the need to install a separate furnace. This reduces up front construction costs even when using a more expensive high efficiency water heater.

### Affordability

Combination water & space heating systems reduce utility costs by 15 percent or more compared to a standard installation of a separate water heater and gas furnace. The savings are even more substantial when the alternative is electric resistance space heating. These systems also usually reduce up front construction costs by eliminating the need for a furnace. Properly sized systems and components will be important to cost effectiveness. In almost all cases combo

systems will eliminate the two to four square feet of floor space dedicated to a chase for the chimneystack. Over the long term, these systems reduce replacement costs by eliminating the need to replace the furnace, since none exists.

### Combo System vs. Conventional

Combo System	Conventional System
<b>Energy Use &amp; Emissions:</b> Reduced energy use and emissions by 15% or more	<b>Energy Use &amp; Emissions:</b> Typically meets code for energy use and emissions
<b>Space:</b> Reduced space requirements due to elimination of furnace and vent or chimney stack chase	<b>Space:</b> Requires 2 to 4 square feet per unit for furnace and vent stack chase
<b>Installed cost:</b> Units cost more, but installation costs are reduced due to elimination of furnace*	<b>Installed cost:</b> Cheaper units, but higher installation costs
<b>O&amp;M cost:</b> Replacement costs are reduced due to elimination of furnace to maintain or replace	<b>O&amp;M cost:</b> Maintenance costs are higher. Maintenance and replacement of furnaces.
<b>Utility Costs:</b> Reduced by 15% or more	

### Is a Combo System appropriate for your project?

Even though combination water and space heating systems have been used for many years and have proven to be very effective for multi-family projects and small homes, there continues to be a great deal of confusion on how to calculate the correct life cycle costs of these systems. In order to get a valid life cycle cost analysis of heating systems the mechanical contractor or engineer should provide the following back-up documentation.

- A narrative detailing each system modeled in each energy analysis. This narrative should discuss results and explain the reasons for unexpected results.

- A copy of the energy analysis showing both inputs and results. Results should show energy use and demand per system per month. The more detailed the results the easier it will be to see errors in the analysis. Inputs can often be incorrect and one mistake at this stage can have a huge impact on the validity of the results.
- A breakdown of installation costs, maintenance costs and replacement costs should be provided with the life cycle cost analysis. References should show how these costs were obtained (i.e. Means Cost data, vendor quotes, a specific past project)
- The performance of a hydronic or combo system is directly dependant on the efficiency of the heater/boiler. Life Cycle Cost Analysis should be performed assuming both code efficiency and high efficiency.

A fair comparison of two options can only be obtained when all other inputs in an energy analysis remain constant while the options in question are changed. Schedules, occupancy, cooling systems and weather are inputs that should be identical in each analysis. It should also be remembered that all BTUs are not created equal. A gas BTU costs less than an electric BTU and has a very different pollution impact.

Combo systems will usually be competitive or less costly than gas water/space heating systems but will cost more to install than gas water heating and electric resistance heating. However electric resistance heating (or water heating) should never be considered energy efficient due to the energy loss that occurs during electric energy generation and the transmission and distribution of electrical energy.

### Installation

Combination space and water heating systems have been commonly used for more than twenty years and have been proven effective for multi-family use. Most qualified mechanical contractors will be familiar with the installation and operation of this system. Gas water heaters used in combination systems should have a minimum energy factor of 0.62 which will provide a combined efficiency of space and water heating of 80 percent or higher. Electric water



heaters must have an efficiency of 90 percent or higher, but the use of electricity for water and space heating is discouraged due to the inefficiency of electricity for these uses.

Water heaters selected for combination applications must be sized to meet the space heating demand of the dwelling in which they will be used. Heating demand should be determined by using the ACCA (Air Conditioning Contractors of America) Manual J. Water heaters sized to meet the heating demand will also meet the domestic hot water needs except when a hot tub or Jacuzzi must be served by the water heater.

- When a combination water and space heating system is used, hot water is circulated more often through the water heater. This results in less build up of calcium deposits in the water heater leading to a longer usable life for the water heater.
- Very high efficiency water heaters are usually direct vent appliances. This means the combustion gasses can be vented through an outside wall, eliminating the need for a vent or chimney stack and adding 2 to 4 square feet of living space that would normally be used for the vent or chimney chase. This also eliminates the possibility of backdrafting of combustion gasses and ensures better indoor air quality.

## Metering

Combination systems can be metered the same way hot water is metered in a multi-family complex or building. If each unit has a separate water heater, gas will already be metered for each unit, so metering for the combo system will already be in place. If the project uses a central boiler, there will typically be meters in place to

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measure hot water use for each unit. The same meter will accommodate metering for a combo heating system.

## Operation and Maintenance

The operation and maintenance of a combination space and water heating system will be the same as for standard water heaters and space heating systems. Maintenance will include regular replacement of filters for forced air systems, annual draining of the water heater to reduce buildup of mineral deposits and annual servicing of the HVAC system.

## For more information

- Gas Appliance Manufacturers' Association - [www.gamanet.org](http://www.gamanet.org) - Consumer's Directory of Energy Efficiency Ratings Heating and Water Heating Equipment
- American Council for an Energy Efficient Economy - [www.aceee.org/consumerguide/topwater.htm](http://www.aceee.org/consumerguide/topwater.htm) - Listing of highest rated energy efficient water heaters and combo systems
- USDOE/EERE - [www.eere.energy.gov/buildings/info/documents/pdfs/26459.pdf](http://www.eere.energy.gov/buildings/info/documents/pdfs/26459.pdf) - USDOE Technology Fact Sheet Heating and Cooling Equipment Selection
- Search Build It Green's **AccessGreen Directory** to find local suppliers and services: [www.builditgreen.org](http://www.builditgreen.org)
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