in energy costs to get their money back in approximately eight to nine years.

FSEC conducted detailed surveys of all program participants. More than 35% of them responded, and the majority said they were quite satisfied with their solar system, had adequate amounts of hot water, and did not experience any inconvenience once the solar system was installed. The survey did reveal, however, that residents needed more education regarding the operation and maintenance of their solar systems.

FSEC also conducted detailed inspections of more than 25% of the 801 systems to make sure they were installed properly and were operating as designed. In general, the inspections revealed that there were few component failures, that most installation discrepancies were easily fixed, and that most discrepancies were related to workmanship rather than to problems with the equipment.

A Solar Success

According to Harrison, FSEC feels that SWAP was quite successful. It showed that solar hot-water systems can be cost-effective in warm-climate states, and that they can offer attractive savings to low-income clients.

The inexpensive, simple, and reliable solar systems used in this program are available to anyone. Although many people express a desire to use renewable energy resources, the high initial costs of conventional solar hot-water systems make them impractical for many consumers. SWAP shows that a reasonable balance between initial cost and final solar fraction can be achieved, thereby making solar hot water more affordable.

SWAP program director John Harrison, FSEC senior research engineer Steven Long, and freelance writer Michael Major contributed to this report.

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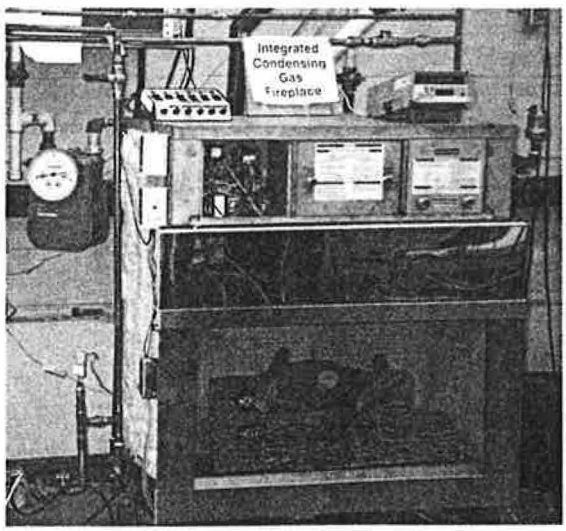
A Bright Future for Advanced Fireplaces

The severe ice storm of January 1998 in eastern Canada and the northeastern United States showed the benefits of efficient gas and wood fireplaces that can operate independently of electricity, and increased interest in high-performing fireplaces that supply comfortable heat during an extended power outage. Conventional fireplaces are woefully inefficient, pollute to the indoors and outdoors, and can even be dangerous. These new fireplaces overcome all three problems. As *Home Energy* has reported in the past (see "Fireplaces: Studies in Contrast," *HE* Sept/Oct '94, p. 27), fireplaces that are safe, efficient, low-polluting, and attractive can be very beneficial—especially in cold-climate areas that may be subject to hazardous weather conditions.

Advances in Advanced Combustion

Recently, a few manufacturers have brought out new or enhanced models of advanced combustion wood-burning fireplaces. The best designs offer an extremely attractive flame, high energy efficiency, and the ability to utilize a renewable energy resource (intelligently harvested wood).



SK@HAYDEN/ACT

This integrated condensing gas fireplace is currently being tested at the Advanced Combustion Technologies Laboratory. It heats tap water, warms household air, and creates radiant heat, all at over 90% efficiency.

Unfortunately, the market has been slow to take up these new fireplaces, for three reasons. First, many builders and renovators, as well as the general public, fail to recognize the superior performance that these new fireplaces offer. Second, the general perception is that burning wood in any manner is inherently polluting. Third, installation of gas fireplaces has seen phenomenal growth in recent years because the public does not understand that some advanced wood-burning fireplaces are as good as, or even better than, many gas fireplaces.

Gas Doesn't Equal Good

Well-designed gas fireplaces offer the potential for good, efficient performance. However, in spite of manufacturers' claims, many so-called efficient gas fireplaces are not well designed. Until recently, standards for measuring gas fireplace efficiency have been inadequate or inappropriate. The Canadian Gas Fireplace Efficiency Standard, CGA-P.4, uses a laboratory procedure similar to the Annual Fuel Utilization Efficiency procedure for furnaces to measure the seasonal performance of gas fireplaces as they are normally installed in Canadian housing. This standard has already been utilized in British Columbia to determine eligibility for their Clean Choice Program, and it has resulted in P.4 efficiencies being developed for a large number of gas fireplaces.

Field trials of gas fireplaces conducted here at the Advanced Combustion Technologies Laboratory (ACT) in 1996 confirmed the performance ranges. A publication by Natural Resources Canada (NRCan) entitled All about Gas Fireplaces recommends that only gas fireplaces with a high P.4 efficiency (60% or greater) be installed. P.4 is currently being expanded to include the positive effects on effi-

ciency of firing rate modulation, which allows the fireplace to be run during milder weather without overheating the house.

An immediate positive benefit of expanding P.4 is that most manufacturers are now making at least some gas fireplaces with good P.4 efficiencies, usually with several characteristics that add to energy efficiency, comfort, and safety in the home. These characteristics can include:

- direct vents, which bring outside air directly into the firebox for combustion;
- good burner turndown, which allows for a lower Btu rate and more efficient use during milding weather;
- ceramic glass for radiant heat transfer from the flame to the room; and
- electronic ignition or a low or easy-to-shut-down pilot light, which cuts down on excess gas use from pilot lights.

NRCan, the gas fireplace industry, and the provincial governments are currently discussing the development of a national appliance labeling program that would make it easy for Canadian consumers to determine differences in performance, based on P.4.

At present, the P.4 standard is limited to Canada; the United States does not have a specific fireplace efficiency standard. Consequently, most efficiency levels quoted by gas fireplace manufacturers in the United States are overestimated—sometimes by a very wide margin.

New Technology for Tight Houses

For the foreseeable future, North Americans will continue to demand fireplaces in their homes. However, heat demands for new houses are getting lower and lower—in Canada, the average heat load for a new house is 40 kBtu per hour. At the same time, fireplace efficiencies are getting higher. An increasingly difficult problem with the energy-efficient fireplaces (both the advanced-combustion wood fireplace and the direct-vent gas fireplace) is how to use the fireplace without overheating the room, especially during shoulder seasons with milder outside temperatures.

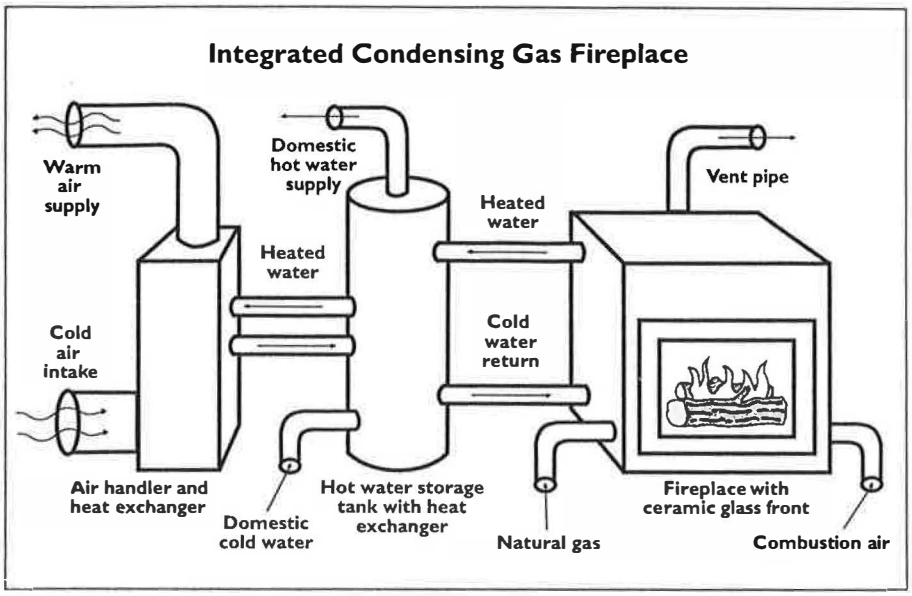


Figure 1. The integrated condensing gas fireplace. Water is heated in the fireplace, then travels to the water heater and the HVAC unit, where tap water and air are heated through heat exchangers. The fireplace does not have to be in use for these heat exchangers to function.

One solution is to make fireplaces that act more like furnaces, with ducts running off the fireplace to other zones in the house. That way, the heat can be supplied to many areas, not just the area where the fireplace is located. At least two manufacturers, CFM and Heat-N-Glo, have recently brought out such fireplaces.

The new "integrated" fireplaces take this idea even further. With the almost universal demand for fireplaces in homes, but less need for heat, the existence of three separate energy sources (furnace, water heater, and fireplace) becomes problematic. The integrated fireplaces solve this problem because they can supply heat to the whole house and also heat the tap water, while giving comfort and visual pleasure in the areas where they are located (see Figure 1). They may even be able to supply fresh air for house ventilation as well, through a heat recovery ventilator built-in with a fan coil. ACT, under its Advanced Integrated Mechanical Systems (AIMS) program, is actively working with Canadian manufacturers to develop the next generation of advanced combustion, high efficiency, integrated fireplaces.

One such unit is currently being tested and modified here at ACT. It is a Canadian-designed high-efficiency gas fireplace with condensing heat recovery. It heats tap water through a secondary heat exchanger, stores hot water in a well-insulated external storage tank, warms air for space heating through an efficient fan coil, and gives comfortable radiant heat from the fireplace flame, all with efficiencies of more than 90%. This is far superior to the efficiency rate of most water heaters and midefficiency furnaces and all fireplaces. Like a midefficiency gas furnace, the device has an electric ignition, an induced-draft fan, and a high-efficiency electronically commutated motor fan set for air circulation.

Snap, Crackle, Breathe

In summary, advanced-combustion wood fireplaces and high-efficiency direct-vent gas fireplaces are now widely available. These fireplaces offer consumers a means to significantly reduce energy use and CO_2 emissions while maintaining a comfortable home with an attractive fire. Many of them can even run without electricity, providing comfortable heating during extended power failures like last winter's ice storm. Finally, fireplaces employ new technology to perform multiple functions at high efficiency. All this makes the future of fireplaces very bright indeed.

—Skip Hayden

A.C. "Skip" Hayden is senior research scientist at the Canmet Energy Technology Center's Advanced Combustion Technologies Laboratory of Natural Resources Canada, in Ottawa, Canada.