Introduction to Home Heating

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ENERINFO ADVISOR SERIES

Reducing Your Heating Costs

- Energy-efficient construction keeps heating costs low and protects against energy price increases.
- Reducing temperatures by 5°C (10°F) overnight can cut heating costs by up to 12 per cent.
- High efficiency heating equipment offers much better long-term value than less-expensive, but lower efficiency heating systems.
- Cleaning and maintaining your heating system regularly is essential for peak efficiency.
- The Nova Scotia EnerGuide for Houses program can provide financial assistance to help pay for energy efficiency improvements.

Introduction

Confused about home heating options? Need to replace your heating system? Building a new home? Want to improve the efficiency and safety of your current heating system? Our *Introduction to Home Heating* will help you to understand and compare home heating options.

It will show you how to compare the typical operating costs of common home heating systems, discuss important safety considerations, and explain why the best way to cut home heating costs is usually to improve your home's energy efficiency first. The home heating decisions you make now will affect your comfort, heating costs, and the environment we all share for years to come. Making an informed choice is important.

Building a New Home?

All new homes or additions should be well insulated, include a tight air barrier and energy-efficient windows, and have an effective ventilation system. The benefits of lower energy costs, improved comfort, and a healthier living environment will quickly repay any additional construction costs. Dollars invested in making a home energy-efficient nearly always deliver greater savings than if the same amount of money were spent on an expensive heating system.

Over the years, most homeowners who "can't afford" energy efficiency will spend thousands of dollars more than they should to heat their houses. That's because a home with high heating requirements will always be expensive to heat, regardless of the type of heating system selected. On the other hand, a well-built energy-efficient home can require so little heat that heating costs will always be affordable, regardless of the type of heating system or fuel selected.

To Switch or Not to Switch?

Are your heating bills too high? High fuel costs are often only a symptom of the real problem – an inefficient building. Before you replace your heating system, check your home for these heat wasters:

- poor insulation
- drafty windows and doors
- air leaks
- inaccurate thermostats
- an inefficient water heater
- poorly maintained heating equipment

Fix these problems before you even consider switching fuels. Hot water costs can be reduced by turning down your water heater's temperature setting to 52°C (125°F), installing low-flow showerheads, and insulating your water heater and hot water pipes. Improved insulation, draft proofing, and other basic home weatherization improvements usually cost less than replacing a heating system and make your home more comfortable too. They're also an excellent investment!

Other Considerations

Fuel is only one part of the real cost of heating your home. There are other important heating cost issues that you should consider.

EQUIPMENT EFFICIENCY

High efficiency equipment is always a sound investment. As energy prices increase over time, savings will become even larger. But "efficiency" alone cannot guarantee low heating costs if the home itself is inefficient or if the heating system uses an expensive fuel.

SEASONAL EFFICIENCY

This factor takes into account equipment design, heat loss up the chimney, reduced performance during warm-ups, energy used by pilot lights, and any decline in efficiency over the heating season. To realistically compare the annual operating costs of different heating systems, you need to know each system's seasonal operating efficiency.

ANNUAL HEATING REQUIREMENTS

Your home's heating requirements should be a key factor in selecting the heating system to best meet your needs. You may be able to quickly recover the higher purchase price of a heating system with low operating costs if your home is an "energy hog." The same heating system in a home with low heating requirements may never save enough to pay for itself.

OTHER COSTS

When evaluating a heating system, don't neglect to include the cost of maintenance, leasing or capital equipment, and the electricity used to operate fans, pumps, motors, etc.

Fuel Cost Comparisons

The table below presents the costs of various fuels as a cost per million British Thermal Units (MMBtu) of delivered heat. An older home might use 60-100 MMBtu per year for space heating. R-2000 homes can use less than 30 MMBtu annually.

Fuel Cost Comparison Chart

Source	Unit	Seasonal Efficiency	Unit Price (no HST)	Price per MMBtu
Oil (old, space heaters)	litres	70%	90¢	$ 36.99
Oil (new)	litres	85%	90¢	$30.46
Electricity	kWh	100%	10.7¢	$32.92
Time-of-use electricity (lowest cost)	kWh	100%	5.3¢	$16.45
Heat pump (air)	kWh	190%	10.7¢	$17.33
Heat pump (water)	kWh	300%	10.7¢	$10.97
Propane (old, fireplace)	litres	70%	95¢	$58.85
Propane (condensing)	litres	93%	85¢	$38.80
Natural gas (condensing)	GJ	93%	$15.66	$18.56
Wood (EPA stove)	cord	70%	$200.00	$12.00
Wood (pellets)	ton	70%	$220.00	$19.47

Note: Prices are as of January 2008 and include applicable taxes (5%). Prices may vary according to supplier, location in the province, quantity consumed, and applicable discounts. Depreciation, financing, and maintenance costs are not included.

CALCULATE YOUR OWN HEATING COSTS

Use the following formulas to calculate the cost per million Btu's (MMBtu) of heat for your home. A qualified technician can measure the efficiency of your heating system. Don't forget to include any applicable taxes in the fuel cost.

Oil:	(27.4 x oil price/litre) / seasonal efficiency*
Electricity:	(293 x cost/Kilowatt hour) / seasonal efficiency or coefficient of performance*
Natural gas:	(1.05 x cost/GJ) / seasonal efficiency*
Propane:	(41.3 x propane price/litre) / seasonal efficiency*
Wood (hardwood):	(0.04 x cost/cord) / seasonal efficiency*
Wood pellets:	(0.059 x cost/ton) / seasonal efficiency*

Example: Joan and Joe heat their home with furnace oil delivered for $.90 per litre, taxes not included. The seasonal efficiency of their heating system is 75 per cent. Their cost per million Btu's of heat is:

$$\frac{27.4 \times 0.90/\text{litre}}{.75^*} = \$32.88 + \text{taxes}$$

*Efficiency expressed as a decimal (e.g., 75% = 0.75)

Heating System Basics

To design a heating system properly, you need to have a room-by-room heat loss calculation done specifically for your home. A qualified heating specialist will calculate heating loads based on a room's outside surface area, insulation levels, window area, air leakage, and ventilation requirements.

Applying rule-of-thumb methods developed for older homes to a new energy-efficient home can result in an oversized or unbalanced system that wastes energy and produces uncomfortable temperature swings.

Basic heating systems have three components:

- the thermostat and controls, which turn the heating system on and off
- the heating appliance (furnace, boiler, or heater), which produces heat
- the distribution system, which moves heat to where it is needed in the home.

Thermostats

Accurate thermostats can maintain temperatures within 1°C (2°F) of the thermostat setting. Good temperature control is essential for comfort and will save you both energy and money.

SETBACK THERMOSTATS

Programmable or setback thermostats automatically lower and raise room temperatures. Reducing the temperature 5°C (10°F) overnight and/or when no one is home can cut your heating bill up to 12 per cent. Programmable thermostats can also improve comfort by warming up your home to a comfortable temperature before you get up in the morning or return in the evening.

LOCATING THERMOSTATS

Thermostats should be located on an inside wall away from drafts or heat sources such as direct sunlight, chimneys, heaters, or floor registers. Accurate temperature control is not possible if the temperature the thermostat "sees" is not the same as the average room temperature.

Heating Appliances

The four most common types of heating appliances are:

- furnaces, which heat the home with warm air
- boilers, which circulate heated water through a radiator, fan coil, or radiant system
- space heaters, which directly heat the space surrounding them
- heat pumps, which upgrade heat from the air, ground, or water using a refrigeration cycle to heat or cool the home.

Distribution Systems

A good distribution system heats the entire home evenly. Common systems are described below.

FORCED WARM AIR

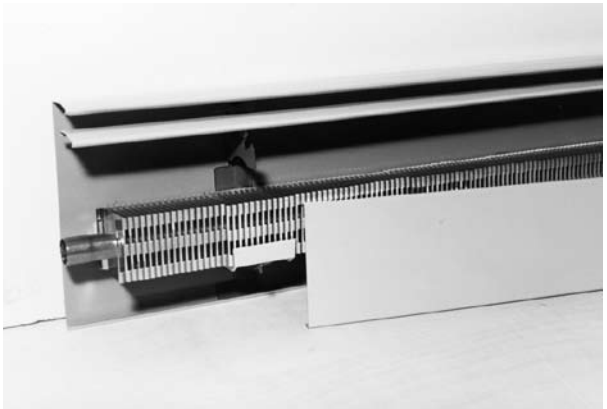
A fan circulates heated air around the home through a system of ductwork. Forced-air systems can also air condition, dehumidify, filter, or humidify the air in your home.

Ductwork must be properly sized and installed for best performance. To prevent air leakage, all joints in both supply and return ducts should be sealed with mastic. To reduce heat loss and prevent condensation, insulate ducts passing through cold attics and crawlspaces to at least R5.

Each level of your home (ideally each room) needs a cold-air return to return air to the furnace. In rooms without a return-air register, undercut doors to create a gap of at least 1 cm (1/2 in) to allow air to exit under the door.

The volume of warm air delivered to each room can be adjusted by opening or closing duct dampers. Open dampers deliver more heat. Partially shut dampers force more airflow to other rooms.

Forced-air ductwork can also be used to distribute air from an air exchanger or heat-recovery ventilation system. However, due to the different volumes of airflow – high for heating systems, low for ventilation systems – separate heating and ventilation duct systems are usually a better option.



Typical hot-water baseboard heater.

HOT WATER (OR HYDRONIC)

Common hydronic heating systems include baseboard radiators, radiant floor or ceiling systems, fan coil units, or, in older homes, large cast-iron radiators. Boilers can also heat domestic hot water, avoiding the space, expense, and maintenance of a separate water heater. Adding zone valves or more than one circulating pump allows some parts of the home to be kept at a lower temperature. Heating pipes passing through cool areas, such as basements and crawlspaces, should be insulated to save energy, improve performance, and prevent freezing.

Baseboard Heaters. Baseboard radiators provide heat to the home via a tube with a series of metal fins. Most systems are designed for water temperatures in the 80°C (180°F) range.

Cast-iron Radiators. Many older homes have large cast-iron radiators. These systems contain a much larger volume of water and run at lower temperatures (65–70°C/150–160°F) than baseboard systems. Circulation can be provided either by gravity or by a circulator pump. Once or twice a season, hot water radiators should be bled, since trapped air reduces a radiator's ability to transfer heat. Hold a pan under the bleed valve and open it until all air has escaped and only water comes out.

Radiant Heat. Hydronic radiant systems provide home heat using a network of water-filled pipes located in or under the floor assembly. Radiant heating systems work best in an energy-efficient building, since their maximum heat output is limited by floor area and acceptable floor surface temperatures. Boiler water temperature must be reduced to 40–50°C (100–125°F) before it can be used in a radiant heating system.

Ceramic tile is an ideal flooring for an in-floor radiant system because tile conducts heat well. Many wood flooring manufacturers recommend floating floor systems with radiant heat, since increasing floor temperatures will also increase the shrinkage of a conventional wood strip floor.

Placement of concrete floor slab on top of radiant floor piping.

Heating with Oil

Oil is the most common home-heating fuel in Nova Scotia. With improved heat exchanger design and flame-retention head burners, today's oil furnaces and boilers are 10 to 15 per cent more efficient than older equipment. New units have steady state efficiency of up to 86 per cent and seasonal efficiencies in the low 80 per cent range.

GETTING THE MOST FROM YOUR BURNER

Annual Maintenance. Oil burners should be cleaned and adjusted annually by a qualified technician. Basic servicing consists of:

- cleaning the soot from the heat exchanger
- replacing the burner nozzle and oil filter
- lubricating motors and pumps
- testing controls
- measuring combustion efficiency
- checking belt tension and cleaning air filters (warm air only)

Modern warm-air oil-fired furnace.

Nozzle Downsizing. If your furnace has a short on/off cycle, downsizing your burner's oil nozzle can save you money. Smaller nozzles improve comfort by evening out interior temperatures. Longer run times, at lower heat output, allow the burner to operate at peak efficiency for longer periods, much like the improved gas mileage of highway driving compared to stop-and-go city driving.

Efficiency Tests. Modern oil burners cannot be accurately adjusted "by eye." The only way your burner technician can be certain your oil burner is working at its best is to physically measure CO_2 or O_2 levels, smoke density, and stack temperatures to determine combustion efficiency. Draft should also be tested. A properly adjusted burner should be at least 81 per cent efficient.

Burner Replacement. If the heating system is still in good mechanical condition, but the burner's combustion efficiency is below 75 per cent, replacing the burner may be a good investment. Burner upgrades have performed particularly well on the cast-iron boilers still heating many older homes. With new burners, these rugged boilers can be surprisingly efficient and provide many years of trouble-free service.

Furnace or Boiler Replacement. Generally it is not a good investment to replace a furnace or boiler unless its combustion efficiency is very low, the heat exchanger develops a hole, or repairs become too expensive.

OIL-FIRED SPACE HEATERS

Natural draft oil-fired space heaters are available in attractive new designs, complete with glass fronts to view the flame. The best units have efficiencies as high as 80 per cent and can heat a small home. Most oil space heaters can operate without electricity.

Exterior direct-vent exhaust hood.

VENTING COMBUSTION GASES

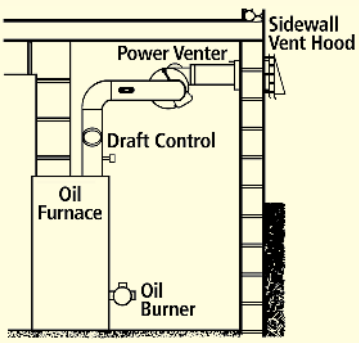
Most new oil systems can be equipped with sidewall venting equipment instead of a chimney. This equipment must be certified for use with specific equipment/burner combinations. It may not be possible to find a location in every home for a sidewall vent that meets all required clearances.

The most common type of venting equipment available now is a direct-vent system. Combustion gases are exhausted by burner fan pressure. Since the exhaust system is pressurized, it must be carefully sealed to avoid combustion spillage into the home.

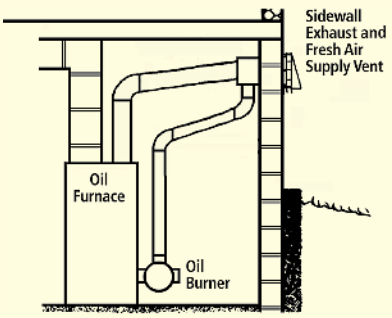
Direct-vent systems with an outside combustion air-feed increase efficiency and decouple the operation of the heating system from any air pressure imbalances that may exist in the home. Advantages of direct-vent exhaust systems over power-venting systems include lower cost, higher efficiency, simplified maintenance, quieter operation, and no requirement for household air.

Direct-vented oil-fired boiler. The domestic hot water tank is under the boiler/burner.

Typical Sidewall Venting Systems



Power-Venting System



Direct-Venting System

OIL TANK STORAGE SAFETY

Fuel oil spillage can result in expensive environmental clean-up costs that may not be covered by some home insurance policies. Homeowners should inspect oil tanks regularly for leakage, damage, proper support, and openings that allow water to enter the tank, such as a missing fill or vent cap or a broken fuel gauge. Exterior tanks should be painted regularly. Older tanks should be replaced. Special tanks designed to minimize the chance of oil leakage include stainless steel tanks, fibreglass tanks, tanks with an outer shell designed to catch oil leakage, and tanks constructed of heavier-gauge metal. A metal pan or a low curb or dyke under the tank can help to contain small oil spills and simplify clean-up.

Double walled oil tank with two pipe fuel line system exiting the top of the tank.

Heating with Electricity

Electricity is the second most common heating source in Nova Scotia. It offers convenience, eliminates combustion or fuel-storage concerns, and provides predictable regulated pricing. Types of electric heating include the following:

BASEBOARD HEATERS

Electric baseboard heaters are quiet, relatively inexpensive to install, and easy to maintain. They are best suited to modest energy-efficient homes with low heating requirements.

Electric baseboard heater.

THERMOSTATS

The inaccurate, older **bi-metal thermostats** used in most homes are usually the cause of the large temperature swings and comfort problems some people may associate with electric heat. These low-quality thermostats can't respond fast enough or accurately enough to keep room temperatures within most people's comfort zone.

Electronic and gas diaphragm **line-voltage thermostats** can almost eliminate temperature swings and will usually save energy, too. Upgrade thermostats in high-use rooms first, since that is where comfort improvements will be more noticeable.

ELECTRIC BOILERS

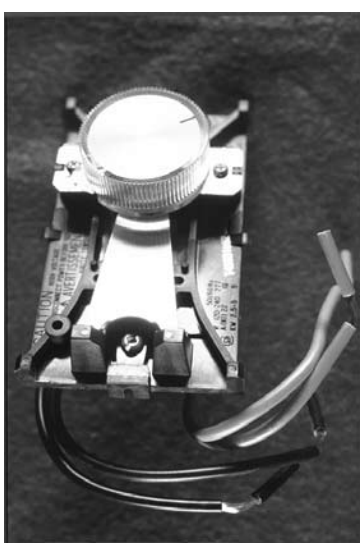
Electric boilers are insulated tanks containing electric heating elements. Electric water heaters can be used as low-cost boilers in very energy-efficient homes.

ELECTRIC FURNACES

An electric furnace combines electric elements and a conventional warm-air duct system.

ELECTRIC RADIANT HEATING

Electric heating elements can be installed in a cement slab or under finished flooring to provide radiant floor heating. Wall or ceiling radiant systems with low-temperature electric heating elements behind the drywall are available but less popular.



Old-style bi-metal thermostat: Not recommended.

HEAT PUMPS

Heat pumps can either supply or remove heat from your home by circulating a refrigerant between two heat-exchange coils. To supply heat, low-pressure liquid refrigerant is evaporated by absorbing low-grade heat from the air, water, or ground. When the evaporated refrigerant is mechanically compressed, the temperature of the gas increases. Heat is released when this pressurized gas condenses back into a liquid. Heat pumps can cool a home by reversing this process.

Types of Heat Pumps. The three main types of heat pumps are air source, water source, and ground source. Water- and ground-source units may also be called earth energy or geothermal systems.

Air-source heat pumps are the most common type of heat pump. They are usually connected to forced-air delivery systems. Air-source heat pumps extract heat from the outside air. As the outside air becomes colder, heating requirements increase, and the heat pump's output drops. Eventually the heat pump cannot meet all of the home's heating requirements without a supplemental source of heat. "All-electric" air-source heat pumps are equipped with supplementary electric resistance heaters. "Add-on" heat pumps operate in tandem with a warm-air furnace.

Air-to-air heat pump – exterior unit.

Air-to-air heat pump – interior unit.

Ground- and water-source heat pumps extract heat from the ground or groundwater for home heating and sometimes hot water. Since groundwater temperatures are largely independent of the weather, ground-source heat pumps can operate at high efficiency throughout the winter.

Heat Pump Efficiency. Heat pumps don't actually create heat; they absorb heat from a low-grade source and upgrade it to a temperature high enough for home heating. A heat pump can deliver more energy than it consumes, since heat pumps move heat rather than create it. The heat pump's overall coefficient of performance or COP (similar to efficiency) increases with the temperature of its heat source, so water-source heat pumps (COP of 2.6 to 3.3) are more efficient than air-source heat pumps (COP of 1.8 to 2.2).

TIME-OF-USE ELECTRICITY RATES

Specialized electric service meters can now record both the time electricity was used and the amount of electricity consumed. This new technology allows utilitities to sell electricity at different rates throughout the day or week, depending on the cost of generation. Homes eligible for Nova Scotia Power's optional "time-of-use" (TOU) rate structure must have heating systems that can shift heating loads to off-peak hours and are approved for TOU rate structures. "All-electric" homes equipped to take advantage of the TOU rates have enjoyed savings as high as 35 per cent on their entire electric bill.

TOU rates charge half the normal kwh rate on holidays, on weekends, and for 8 hours overnight (about 4760 hrs/year). For 12 hours on weekday mornings and evenings in December, January, and February (about 816 hrs/year), electricity is sold for 50 per cent more. Standard electric rates apply for the remaining 3184 hrs/year. Annual base connection charges for TOU meters are $110 higher than for a conventional service.

Common types of heating systems approved for TOU rates are electric thermal storage heaters and high-mass radiant floor systems.

Electric thermal storage heaters. These devices store heat in an insulated box containing thermal mass heated during time periods when electric costs are low. Heat is delivered to the home as required using a small fan to blow air through the heat-storage medium.

Electric thermal storage heater.

High-mass radiant floor systems. Homes with high-mass radiant floor systems are also eligible for TOU rate structures. Off-peak heat can be stored both in the slab itself and as hot water in an insulated tank. A conventional electric water heater has enough capacity to heat a modestly sized energy-efficient home.

Heat storage systems eligible for time-of-use rates are also available for burners, boilers and heat pumps.

CALCULATING THE COST OF ELECTRIC HEAT

It is easy to forget that your electric bill also includes household electrical use and usually hot water. To compare the cost of electric heat to other heating options, you must separate the cost of other household electricity use from home heating.

Here's a simple way to estimate electric heating costs. Multiply your lowest summer (non-heating) bi-monthly bill by 6. Add 10 per cent to account for extra winter electricity use. Deduct this figure from your total annual electric costs. The difference is a rough estimate of your annual space heating cost.

Example:

Annual electricity cost =	$2,700
Lowest two-month bill	$170
	x 6
Annual cost	$1020
Add 10% for extra winter use	+ 102
Estimated non-heating cost	$1,122
Estimated annual heating cost =	$1,576

Heating with Gas

Propane and natural gas are similar fuels, with important differences.

Propane is delivered by truck and stored as a liquid in a pressurized storage tank on your property. Storage tanks are usually rented from and maintained by the propane supplier. Propane is sold by volume, is heavier than air, and contains a third less energy per litre than heating oil.

Natural gas is composed primarily of methane, is lighter than air, and burns only when the fuel/air ratio is between 4 and 14 per cent. Nova Scotia's first residential natural gas service began in January 2004.

In Nova Scotia, natural gas is supplied to residential customers as a low-pressure gas via underground polyethylene pipe. Customers are billed for the heating value, measured in gigajoules (GJ), of the gas consumed.

Most gas equipment can be modified to burn either propane or natural gas. Residential uses for natural gas include home heating, domestic hot water, cooking, clothes drying, barbecuing, and even outdoor lighting.

High-efficiency condensing gas furnaces can have efficiencies of 93 per cent or more. Exhaust gas temperatures from a condensing furnace are so low that they can be safely vented through a low-cost plastic sidewall venting system.

Propane fireplaces are popular in Nova Scotia, especially in new homes. They're clean burning, easy to ignite, and need little maintenance. Many models can be vented directly through an outside wall. Electric blowers can help distribute heat. If you plan to use a gas fireplace as a space heater, be sure to purchase an energy-efficient model. Some less-expensive units are intended only for occasional use and are not efficient enough to provide economical space heating.

For optimum efficiency and safe performance, gas appliances must be cleaned and adjusted regularly by a qualified technician.

Heating with Wood

Wood is a very economical, renewable source of heat if a low-cost supply of wood fuel is available.

WOOD STOVES

Modern, clean-burning wood stoves and fireplace inserts that meet EPA standards are up to 33 per cent more efficient and pollute up to 90 per cent less than many older stoves. Improved combustion chamber design is the key to better performance. As a result of their increased efficiency EPA-approved stoves can burn up to 30 per cent less wood than typical non-EPA stoves.

WOOD-BURNING FURNACES AND BOILERS

Wood furnaces and boilers can comfortably heat an entire house, but may be a poor choice for homes with low heating needs; their high heat output may cause overheating, inefficient operation, and creosote buildup.

Wood furnaces and boilers are generally less efficient and produce more emissions than modern wood stoves. Wood/oil units that share a combustion chamber tend to be less efficient than separate oil- and wood-fired equipment.

Wood-fired central heating systems can be dangerous if overheating occurs as a result of fan failure or a power outage. Safety features are included in their design, but careful sizing, installation, operation, and maintenance are the best defence against fire or smoke damage. Wood furnaces cannot be connected to most existing oil-fired warm air systems unless ductwork clearances from combustible surfaces are increased substantially.

CHOOSING A WOOD STOVE

Smaller is Better. For maximum efficiency, make sure your wood-burning equipment is not oversized. A small stove that operates at high efficiency for the majority of the heating season is a much better choice than a high output stove that overheats your home on all but the few coldest winter nights.

Insist on an EPA-certified Stove. Good-quality wood-burning devices carry an EPA label certifying performance. EPA stoves deliver more heat from each load of wood burned and reduce emissions.

SAFE OPERATION WITH WOOD

Installation. Wood-burning equipment must be carefully installed to be safe. Hire only installers and chimney sweeps who have completed Wood Energy Technical Training (WETT) courses. Have your chimney carefully inspected to be sure it meets the demanding requirements of wood combustion.

Maintenance. Chimneys and flue pipes must be inspected regularly for creosote buildup and other unsafe conditions. Chimneys should be cleaned at least once a year. Cleaning may be needed every few weeks if green wood is burned, the stove is oversized, long slow burns are common, or if the flue pipe between stove and chimney is too long (it must not exceed 3 m/10 ft in length). For new installations, inspect chimneys and piping every month until you've determined how often your system needs cleaning.

Safe Burning. Older, oversized, low-cost, or home-made wood-burning equipment can produce large quantities of noxious smoke. Visible or smelly smoke is unburnt fuel from incomplete combustion. It is usually caused by restricting the air supply to the fire. Incomplete combustion increases fuel cost, fuel use, creosote buildup, and the risk of a chimney fire or poisonous gas leakage.

For a clean, efficient burn:

- Choose a high-efficiency and low-emission EPA-certified appliance.
- Season your wood before burning (air dry under cover for a minimum of nine months).
- Maintain hot fires (large hot fires during very cold weather, small hot fires during milder weather).
- Avoid starving the appliance of air. Keep draft controls open as much as possible. Control heat output by the amount of fuel supplied.

One cord of seasoned hardwood (moisture content under 18 per cent) burnt in an efficient appliance should produce the same amount of heat as 500 litres of oil or 4400 kilowatt-hours of electricity.

WOOD PELLETS

Wood pellets are made from waste wood that has been formed under high pressure into small cylindrical pellets. These pellets are homogenous, dry, and easy to burn. They are sold in easy-to-handle bags, so fuel storage is clean. Fuel hoppers usually hold at least a full day's worth of pellets. Pellets are automatically fed to the combustion zone by a small motorized auger.

Pellet-burning appliances include space heaters, fireplaces, furnaces, and barbecues. Unlike conventional wood-burning equipment that relies on natural draft, wood-pellet appliances have two small blowers. One supplies the combustion air needed for a clean, efficient burn, the other delivers heated air to the home. During a power failure, pellet stoves can't function unless provided with a battery backup.

Combustion gases produced by wood-pellet heaters contain virtually no creosote. They're also cool enough to be safely vented through a side wall, although vertical venting is recommended to provide sufficient draft to empty the combustion area of smoke in the event of an exhaust fan failure or power outage.

PASSIVE SOLAR

Passive solar energy is energy from the sun that enters the home through south-facing windows. It is one of the best and least expensive ways to reduce annual energy costs. On sunny winter days, even cold ones, passive solar homes usually don't need any additional heat during daylight hours. Solar heating can be designed into almost any new home or major renovation. In an energy-efficient building, the sun can supply 30 to 60 per cent of home heating, and it's free.

DOMESTIC HOT WATER

Hot water can be a major household expense. Some energy-efficient homes actually use more energy to heat water than they use for home heating! For information on how to reduce your hot water costs, ask for the *Hot Water Answers* brochure.

Home Heating System Comparison Chart

Fuel Type	Efficiency	Fuel Costs	Fuel Price Stability	Fuel Storage	Installed Cost	Maintenance	Space Requirements	Venting	Comments
Oil	Moderate	High	Low	Need Tank	Moderate to High	Moderate	Moderate	Direct Vent or Chimney	
Electric Baseboard	High	High	High	None	Low	Low	Low	None	
Electric TOU Rates	High	Moderate	High	None	Moderate	Low	Low	None	Electric Savings Also
Heat Pumps	Very High	Moderate	High	None	Moderate to High	Moderate	Moderate	None	Can Also Cool Home
Propane	Moderate to High	High to Very High	Low	Rented	Moderate	Low to Moderate	Moderate	Direct Vent or Chimney	Pilot Lights Reduce Efficiency
Natural Gas	Moderate to High	Moderate	Moderate	None	Moderate	Low to Moderate	Moderate	Direct Vent or Chimney	Pilot Lights Reduce Efficiency
Fuel Wood	Low to Moderate	Low to Moderate	High	Large Area Required	Moderate	High	Moderate to High	Chimney	Renewable Local Fuel; Don't Need Electricity
Wood Pellets	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Direct Vent or Chimney	Renewable Local Fuel, Clean Burning

Combustion Spillage

Spillage of combustion gases into the home from burning fuel can have serious health implications. Exhaust fumes can contain toxic chemicals that can aggravate breathing problems like asthma or cause chronic headaches, serious illness, or even death.

Dangerous combustion gas spillage incidents are occurring more often. Combustion spillage can occur in any age of house and is not limited to "tight" houses or newer-style furnaces, fireplaces, or stoves. Exhaust systems such as range hoods, clothes dryers, vented central vacuum systems, or unbalanced ventilation systems often play a pivotal role in spillage problems.

Low-cost smoke and carbon monoxide detectors can provide an early warning of a major spillage problem.

SIGNS OF COMBUSTION SPILLAGE

- Combustion odours or smoke anywhere in your home.
- Soot stains on the outside of any combustion appliance, flue pipe, or interior chimney.
- Repeated headaches, eye and throat irritation, or a hard-to-diagnose health ailment.

Establishing good draft can be very difficult in an uninsulated exterior chimney.

Causes of Combustion Spillage

POOR CHIMNEY DRAFT

Vent your heating system properly! A chimney that is too large or too small, has blockages, or is very cold upon start-up of the heating appliance may not vent combustion gases properly. As a first step to avoiding dangerous spillage, combustion appliances need chimney or venting systems that are properly designed, installed, and maintained.

Chimneys work best when they are located inside the heated envelope of the home. Warm interior chimneys have better draft and a lower potential for combustion spillage, gas condensation, or creosote buildup. As a bonus, heat lost through the chimney walls remains inside the home. Interior chimneys also tend to be more durable, since they are protected from the elements.

Older chimneys may not perform acceptably with the low flue gas volume and temperatures of today's high-efficiency heating equipment, especially if the chimney is located on an outside wall. These appliances require smaller flues than older units. Flue relining may solve this problem. Consult a heating contractor or appliance supplier to make sure your chimney is properly sized.

Chimneys should be inspected annually. Chimneys serving wood-burning appliances should be swept at least once a year. If your chimney needs to be cleaned more frequently, it may mean that the installation, fuel, or operation of the system needs improvement.

EQUIPMENT PROBLEMS

Heating appliances should be serviced and inspected at least once a year for combustion gas leaks, especially from cracked or corroded heat exchangers. Servicing could be as simple as replacing door gaskets on a wood stove. Cleaning, tune-up, a safety check, and efficiency testing are required annually for oil-fired appliances.

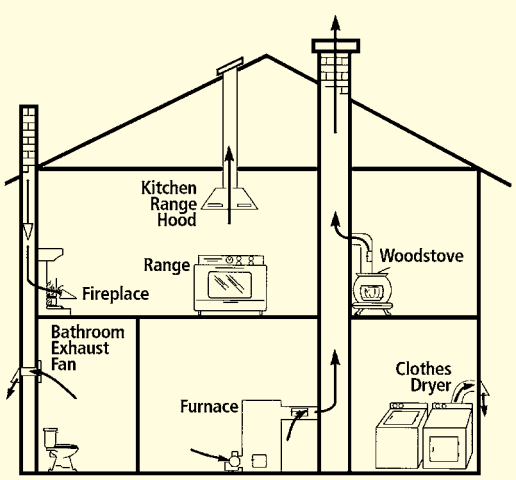
HOUSE DEPRESSURIZATION

If the air pressure in your home becomes negative, exhaust gases from the heating appliance or venting system can be drawn into the home. Negative pressure can be caused by:

- a large exhaust fan (e.g., down-draft range-top fan)
- a combination of exhaust appliances or fans being used at the same time (central vacuum, dryer, range hood, bathroom fan, air exchanger, etc.)
- high winds affecting interior house pressures, especially in drafty houses or those with a window partially open on the upper floor or downwind side of the house
- more than one combustion device operating at the same time.

Combustion Spillage

Flue gases are drawn down the fireplace by the operation of exhaust appliances.



INSUFFICIENT COMBUSTION AIR

Heating appliances need an adequate supply of air for combustion. Modern direct-vent appliances can obtain combustion air directly from the outside. Heating appliances without an adequate supply of combustion air may back draft other nearby combustion devices.

Fixing a Combustion Spillage Problem

Fixing a combustion spillage problem will nearly always require expert help. Look in the yellow pages under "Heating and Ventilation Contractors." Some of the solutions they may suggest are:

- Provide the spillage-prone appliance with its own properly sized chimney and/or a dedicated supply of combustion air.
- Locate the appliance and chimney for safest operation. For example, it can be very difficult to establish enough draft for proper operation in a basement stove or fireplace, especially if it is vented through an uninsulated exterior chimney. Back-drafting problems are particularly difficult to prevent as the fire dies down. If back drafting occurs when the unit isn't operating, air entering via the chimney may develop a smoky smell.
- Determine which exhaust systems interfere with proper venting of the combustion appliance. A standard test using sensitive pressure-measuring equipment is available to tradespeople to identify unbalanced air pressures in housing. Ask for HRAI, WETT, NECA, or R-2000-certified personnel.
- Use sealed combustion or direct-vent appliances that don't need indoor air to operate. They are readily available for oil, propane, and wood-pellet appliances and use air-tight connections between the exhaust outlet and the exterior and between the combustion air inlet and the exterior. Barometric dampers and/or draft hoods are not required.

The ENERinfo Advisor Series

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Other Information Sources

Canada Mortgage and Housing Corporation
www.cmhc-schl.gc.ca

Office of Energy Efficiency
http://oee.nrcan.gc.ca/oee_e.cfm

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