Heating Systems

CO_2RE Home$avers

Take Action on Climate Change

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About CO_2RE

Created *by* Edmontonians *for* Edmontonians…

Carbon Dioxide Reduction Edmonton (CO_2RE) is the City of Edmonton's community-based strategy to permanently reduce local greenhouse gas emissions.

The CO_2RE Strategy was developed by representatives from the residential, business, industrial, institutional sectors and not-for-profit organizations who worked with the City to develop a single, coordinated plan. The group, known as the CO_2RE Team, consulted extensively with many local groups and organizations to develop a consensus on the best approach and strategies. CO_2RE was launched to the public in 2004.

The CO_2RE mission is to work with Edmonton residents, businesses, institutions, non-profits, and industry to provide services, programs and initiatives to assist in reducing energy use, thereby reducing the levels of the GHG (greenhouse gas) emissions that are responsible for Climate Change.

The Original CO_2RE goals include:

- up to a 6% reduction in GHG emissions (from 1990 levels) by the year 2010 and
- a 20% reduction in GHG emissions (from 1990 levels) by the year 2020.

Current Status

Edmonton's GHG emissions increased from 13.9 million tonnes in 1990, to 18.2 million tonnes in 2008 (the most recent year of data), an increase of approximately 38%. Much of this increase is attributable to Edmonton's 24.3% population growth, as well as significant economic growth during this period.

On a per capita basis, GHG emissions appeared to have peaked in 2001 at 29 tonnes of CO_2 per person per year. Since then per capita emissions have continued to fall.

Do your part…

We can do many things to reduce our emissions – and that includes making our homes and lifestyles more energy efficient. The publications in this series are a first step, providing Edmontonians with specific how-to guides on improving home energy efficiency, saving money and reducing GHG emissions.

For more ideas on how to become more energy efficient, log onto our website at **www.edmonton.ca/co2re!**

Free Membership

Why get a membership? Becoming a CO_2RE member is free and the more people who join us in taking action on climate change, the faster we will achieve our goals. CO_2RE is working with local companies to offer incentives on energy-efficient products and programs to further assist residents. You'll also receive a regular newsletter with new ideas and updates. Sign up today at **www.edmonton.ca/co2re.**

Organizations or individuals in the industrial, commercial, and institutional sectors can contact our commercial coordinator by calling 311.

Introduction

This booklet is designed to help you understand your home heating system and the potential benefits of upgrading to new high-efficiency equipment. The figures provided in this booklet are based on the analysis of the results of 4,000 NRCan EnerGuide for Houses (EGH) assessments completed on Edmonton homes.

In Edmonton, over 95% of heating systems are fuelled by natural gas, usually a forced-air furnace or boiler. With continually increasing natural gas costs, home heating costs are consuming an ever-larger portion of our budgets.

Burning natural gas to heat our homes also releases greenhouse gases (GHGs) into the atmosphere. Greenhouse gases are a major contributor to global warming and climate change.

If your heating system is in need of replacement, new energy-efficient equipment is available which will significantly reduce your heating bills and the resulting GHG emissions.

In addition to information on heating systems and efficiency, this booklet includes maintenance tips for existing heating systems. The efficiency of a well maintained, properly operated heating system can be improved by 10 to 15% and ensures your heating system is efficiently using the energy you pay for.

Thermostats

A no-cost action that really saves money is to manually turn down the furnace thermostat before you go to bed at night to 17°C (63°F) instead of leaving it at 20°C (68°F) and by turning it down during the day when no one is home. Each 1°C setback, if done regularly during the heating season, can reduce your annual heating bill by 1 to 2%.

Programmable thermostats are available that you can easily program to automatically alter nightly and daily temperature settings to maximize savings and comfort. You can purchase a simple programmable thermostat for as little as $30 to $80.

Setting back the temperature each night from 21°C to 17°C can reduce yearly heating fuel usage and costs by 4 to 6%.

Programmable thermostats ensure that temperature settings are altered each and every day. Override switches on the thermostats enable the bypass of automatic settings so you can raise or lower the temperature when necessary.

The following example shows the savings possible by installing and using a programmable thermostat to automatically setback the temperature for an average Edmonton home, assuming a natural gas cost of $10 per gigajoule (GJ).

Programmable Thermostat Savings Example

Average Heating Costs	**= $1,800 yearly**
New Thermostat Costs	**= $30 to $80**
Yearly Savings (6%)	**= $108**
Payback Period	**= 4 to 9 months**
GHG Reductions	**= 500 kilograms/year (1/2 tonne/year)**

These thermostats use a 24-hour clock or timer programmed to raise and lower the settings for specified time periods. Units are available that control two or more setback periods for each day and most offer five or seven-day programs so that weekends are programmed separately. Most replacement units use the existing low voltage wires from your current thermostat.

Many residents choose to install their programmable thermostat themselves. When installing or replacing a thermostat, place it on an inside wall away from drafts, direct sunlight and heat sources such as refrigerator, heat ducts or a chimney behind the wall. Mount the thermostat about 1.5 metres (5 feet) from the floor.

It doesn't matter if you have a conventional, mid or high-efficiency heating system. Installing a programmable thermostat to setback temperatures will save you money and reduce your greenhouse gas (GHG) emissions.

Heating System Efficiency

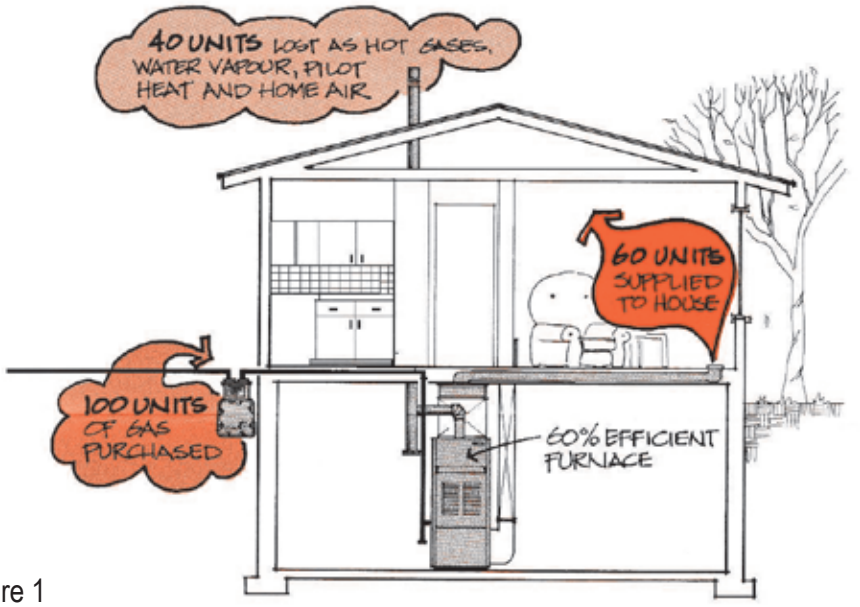


Figure 1

All heating systems are rated on a percentage basis out of 100%, which refers to the unit's efficiency. For example, a furnace that uses only 60 of every 100 units of incoming energy to heat the home is 60% efficient (Figure 1).

The table below shows a **Low**, **High** and **Average** yearly heating system gas usage for Edmonton homes.

Area homes are grouped by age, building characteristics and analysis of 4,000 EnerGuide audit results. Where does your home fit for usage and heating costs?

Home Age	Low Usage	High Usage	Average Usage	Average Cost *
1900-1919	108.02 GJ	725.07 GJ	279.64 GJ	$2,796
1920-1929	54.86 GJ	691.67 GJ	271.63 GJ	$2,716
1930-1939	90.57 GJ	477.84 GJ	233.14 GJ	$2,331
1940-1949	74.74 GJ	510.71 GJ	192.88 GJ	$1,928
1950-1959	65.76 GJ	1,226.16 GJ	181.52 GJ	$1,815
1960-1967	62.61 GJ	604.51 GJ	183.78 GJ	$1,837
1968-1979	49.67 GJ	579.04 GJ	187.27 GJ	$1,872
1980-1989	46.08 GJ	536.18 GJ	184.01 GJ	$1,840
1990-2003	44.76 GJ	352.09 GJ	150.81GJ	$1,508

** Based on cost of $10/GJ including fixed charges, variables, GST, etc.*

Average natural gas usage for heating a single-family home is about 160 GJ yearly, which produces approximately 7,948 kilograms or 7.9 tonnes of GHG a year.

Understanding Heating Systems

Space Heating

In about 90% of Edmonton homes, heat is delivered as circulated warm air through a central forced-air system. Other homes use baseboard or in-floor heating that rely on radiation and natural convection to distribute the heat. Some homes use systems combining both methods of heat delivery.

Forced-air Systems consist of a furnace with a fan to heat and circulate air; supply ducts to carry warm air to each room and return ducts to draw cool air back to the furnace (Figure 2). A centrally located thermostat regulates furnace operation.

With a forced air system, house air can easily be humidified, filtered or cooled. If the furnace fan is run continuously, circulated air maintains more uniform temperatures throughout the home, balancing out spot overheating caused by solar radiation, a woodstove or fireplace. Continuous fan operation however, will substantially increase your electrical costs, natural gas usage and total GHG emissions.

If you need to maintain continuous air flow for comfort or ventilation purposes (to distribute ventilation air from a Heat Recovery Ventilator or fresh air supply) you should consider upgrading your furnace motor to an Electronically Commutated Motor (ECM) or purchase a new high-efficiency furnace equipped with an ECM motor.

Recent testing of ECM furnace fan motors shows a reduction in electrical usage of about 70%, with a savings potential of about 1,500 kWh a year ($100/year) over a standard furnace fan motor.

Currently, 90% of forced-air gas furnaces come in one of three types: conventional, mid-efficiency and high-efficiency.

On December 31, 2009 the federal government implemented a minimum energy performance standard for gas furnaces. All furnaces manufactured as of that date must be high-efficiency furnaces. This does not affect the furnace that is currently installed in your home, and you may still be able to purchase mid-efficiency furnaces as suppliers deplete their inventory. The higher the efficiency, the greater the percentage of heat delivered per unit of fuel used, lowering your costs and your GHG emissions.

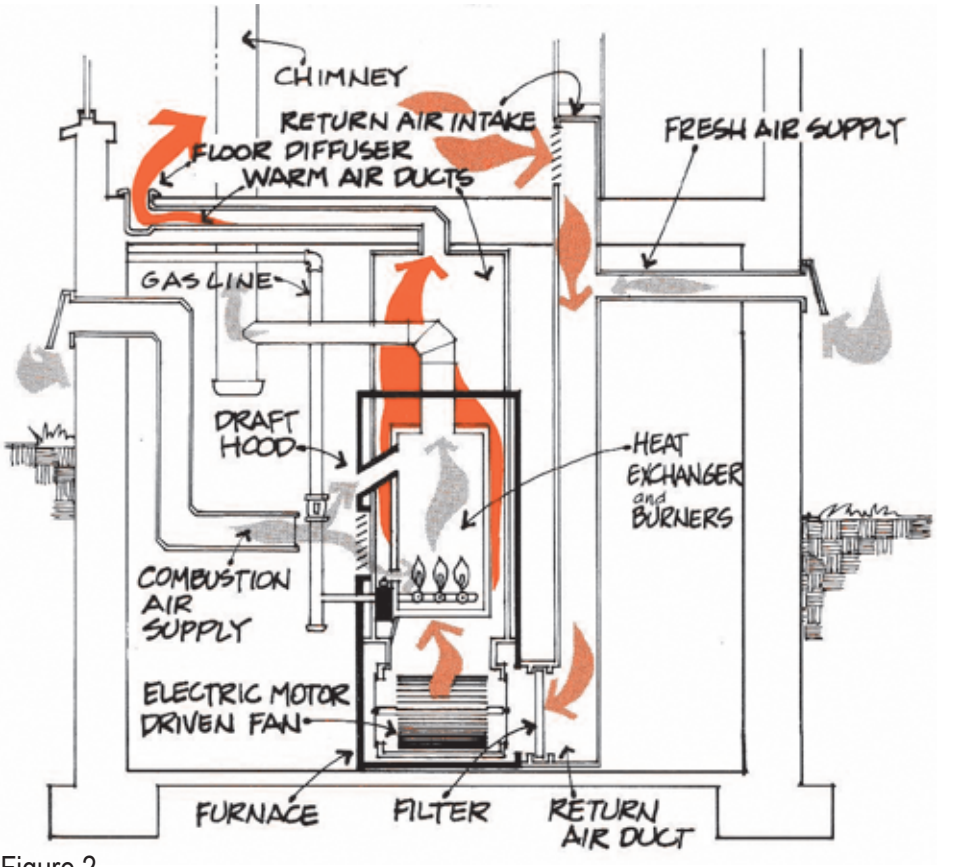


Figure 2

Conventional Furnaces (Figure 2) are still the most common units in Edmonton homes built prior to 1984.

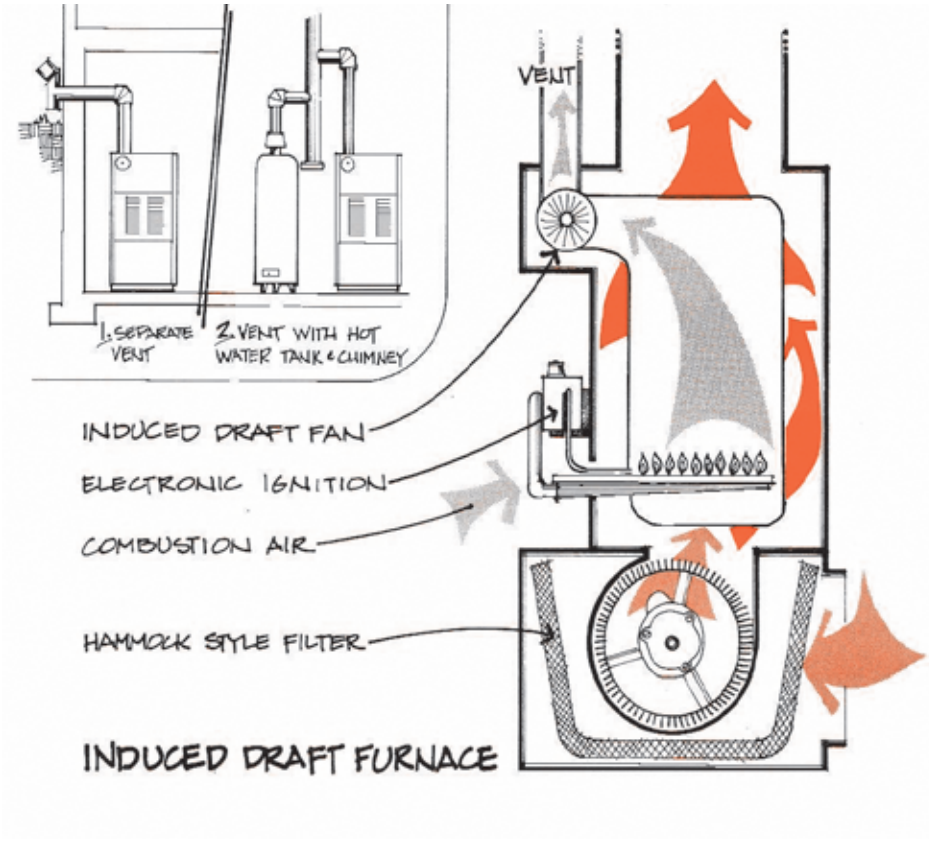
The main disadvantage of these units is a low seasonal efficiency of 50 to 60% due primarily to chimney heat loss, continuous pilot lights and older heat exchanger technology.

In a conventional furnace, 10 cubic feet of warm house air are required to efficiently burn one cubic foot of gas. Another 10 to 14 cubic feet of house air are drawn into the furnace through the draft hood and exhausted, along with combustion gases, through the chimney.

The warm house air is lost up the flue and replaced by cold outside air leaking in through the house shell, which then must be heated. This significantly reduces the overall efficiency of the system. Although replacement parts are still available, manufacturers stopped producing conventional furnaces in 1984.

Mid-efficiency Furnaces achieve seasonal efficiency of about 75 to 80% (Figure 3) by combining an induced draft fan (which replaces the draft hood) and electronic ignition (no continuous pilot light).

The fan draws a controlled amount of combustion air into the furnace and exhausts combustion gases outside through a standard B-vent chimney. Some earlier models



offered sidewall venting systems but operational problems have caused most manufacturers to use standard B-vent chimneys instead.

As per **Alberta Building Code requirements**, combustion air must be supplied to within two feet of the furnace through a separate fresh air supply duct. This duct supplies combustion air directly to the furnace and should be equipped with a motorized damper controlled through the unit or thermostat to eliminate any potential for cold drafts.

High-efficiency Condensing Furnaces use induced draft operation and electronic ignition combined with an extra heat exchanger, which extracts more heat from the combustion gases (Figure 4).

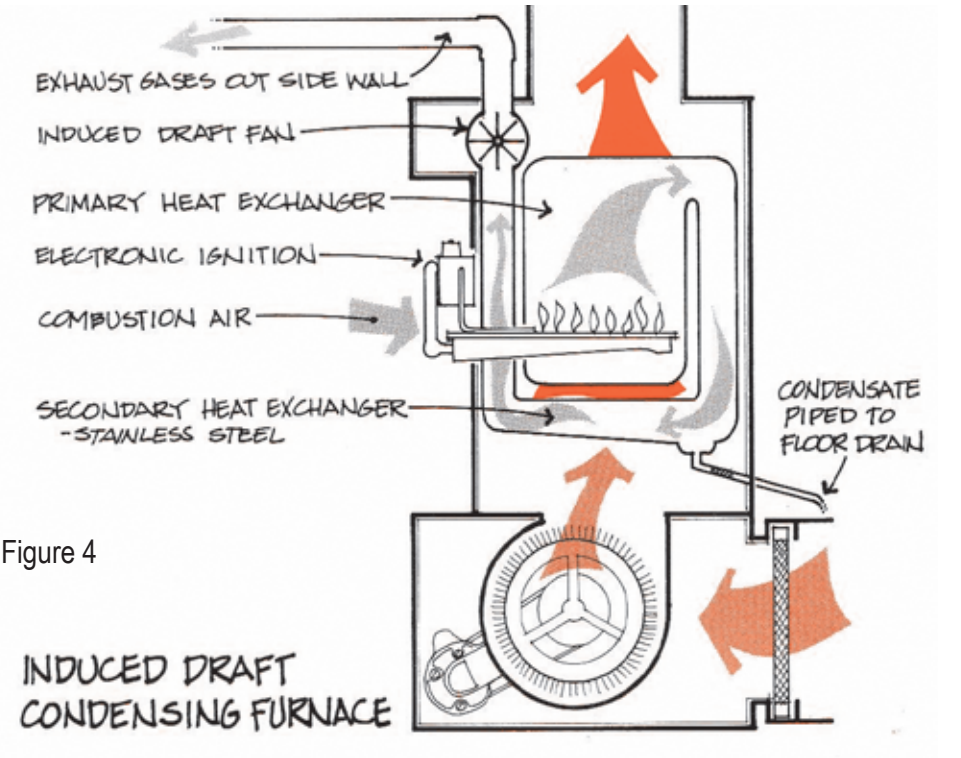


Figure 4

Efficient heat exchange and the absence of a chimney contribute to condensing furnaces seasonal efficiency of 90 to 95%.

Exhaust gases are vented outside through a two-inch diameter flue. When the temperature of the gases falls below a specified level, water vapour condenses and releases additional heat. These furnaces are available from a variety of manufacturers and are referred to as condensing furnaces.

The water condensate, mildly acidic and corrosive, **must be piped directly to a proper floor drain or laundry tub**. All furnace parts, which are in contact with the

condensate, are made of materials that are highly resistant to corrosion. (The extra heat exchanger may be made of aluminized steel, stainless steel or ceramic-coated steel and the exhaust flue of plastic.)

Upgrading your furnace to a high-efficiency unit can provide substantial cost savings and GHG emission reductions. Even if your existing furnace is still running well, it may be time to consider upgrading to a high-efficiency unit.

Considering that the increases in natural gas costs over the last few years are forecast to continue, investing in a high-efficiency system offers good financial return and ongoing savings. Even if you're not planning on keeping your current home for long, a high-efficiency furnace is an attractive feature for potential homebuyers and adds resale value to your home.

Your investment will not only save you money, it will reduce your share of the greenhouse gas emissions responsible for global warming and climate change.

Five example tables are provided using averaged figures from 4,000 Edmonton EnerGuide audits to show the natural gas, costs and GHG savings possible from upgrading to a high-efficiency furnace.

Gas costs are based on an estimated average total cost of $10 per gigajoule (GJ), which includes all current charges, fees and taxes.

Example tables are based on upgrading to a high-efficiency furnace of 90% efficiency or better. Although the initial cost of the high-efficiency furnace is more than the mid-efficiency unit, today's high fuel costs will result in greater cost savings and larger reductions in GHG emissions. You can increase your savings beyond those shown in the table by upgrading to a 92% (or higher) efficiency furnace with a **variable speed motor.**

Gas usage figures provided are in gigajoules (GJ) and were derived from averaged yearly billing figures provided by homeowners for local EnerGuide home audits.

Local costs for the purchase and installation of a high-efficiency furnace have ranged between $3,000 and $7,000 depending on legislation, availability, and incentives.

Upgrading to a High-efficiency Furnace

Example 1 – Homes 1900 to 1939

EnerGuide Results	Gas (GJ)	Yearly Costs	Tonnes GHG
Average Gas Usage	261	$2,614	12.98
Potential Gas Savings	162		
Potential Cost Savings *		**$1,623**	
GHG Savings ** (CO_2)			**8.06**

A 62% reduction in yearly heating costs, a 2-year payback and personal GHG emissions reduction of 8.06 tonnes a year.

Example 2 – Homes 1940 to 1967

EnerGuide Results	Gas (GJ)	Yearly Costs	Tonnes GHG
Average Gas Usage	186	$1,860	9.24
Potential Gas Savings	108		
Potential Cost Savings *		**$1,089**	
GHG Savings ** (CO_2)			**5.42**

A 58% reduction in yearly heating costs, a 3-year payback and personal GHG emissions reduction of 5.42 tonnes a year.

Example 3 – Homes 1968 to 1979

EnerGuide Results	Gas (GJ)	Yearly Costs	Tonnes GHG
Average Gas Usage	187	$1,872	9.30
Potential Gas Savings	104		
Potential Cost Savings *		**$1,040**	
GHG Savings ** (CO_2)			**5.17**

A 55% reduction in yearly heating costs, a 3-year payback and personal GHG emissions reduction of 5.17 tonnes a year.

Example 4 – Homes 1980 to 1989

EnerGuide Results	Gas (GJ)	Yearly Costs	Tonnes GHG
Average Gas Usage	184	$1,840	9.14
Potential Gas Savings	89		
Potential Cost Savings *		**$895**	
GHG Savings ** (CO_2)			**4.45**

A 48% reduction in yearly heating costs, a 3.5-year payback and personal GHG emissions reduction of 4.45 tonnes a year.

Example 5 – Homes 1990 to 2003

EnerGuide Results	Gas (GJ)	Yearly Costs	Tonnes GHG
Average Gas Usage	150	$1,508	7.49
Potential Gas Savings	46		
Potential Cost Savings *		**$467**	
GHG Savings ** (CO_2)			**2.32**

A 30% reduction in yearly heating costs, a 7-year payback and personal GHG emissions reduction of 2.32 tonnes a year.

** Based on costs of $10/ GJ*
*** Greenhouse Gas Emission (GHG) savings based on average gas usage savings.*

Most homes constructed after 1995 are equipped with mid-efficient furnaces. Pre-1995 homes with conventional furnaces would realize similar average savings as shown in Example 4 for 1980 to 1989 homes.

Even if your home is already equipped with a mid-efficiency furnace, it may make economic sense to take a look at the cost savings and GHG reductions that a high-efficiency furnace could provide.

If you know what your yearly cost is for natural gas (subtract 20% from the total gas bill if you have a gas hot water tank) you can compare your costs to the matching tables to get a fairly good idea of how much you could save.

To determine your annual space heating costs, total your monthly gas utility bills for one year. If you have not saved them, contact your gas supplier and request a record of your consumption over the previous year.

Other factors such as house size, family lifestyle, insulation levels and construction quality also influence your annual heating costs. **Remember:** regular maintenance or the lack of maintenance has the most direct impact on overall efficiency and the costs of operating any natural gas forced air heating system.

Purchasing a New Furnace

There can be a number of reasons for replacing an existing forced-air furnace with a high-efficiency unit. The existing furnace may be worn out. A furnace inspection may reveal serious problems, such as holes or cracks in the heat exchanger, rusting of structural components, burner deterioration or blower motor failure. These problems are best remedied with a new unit.

Older furnaces that have been converted from other fuels to natural gas or from gravity to forced air may have parts that are impossible to replace. Chimney leaks, condensation from improper operating temperatures or humidifier overflows may have contributed to the problems.

The environmental and cost savings achievable with the installation of a high-efficiency furnace are also significant reasons to consider replacing your current furnace.

For safety reasons, any problem that allows combustion gases to escape into the home must be remedied immediately to avoid dangerous health and safety problems. Contact your gas company representative immediately if you suspect that exhaust is leaking in your home.

Note: Heating permits are required for the installation of heating systems and related equipment. Contact the City of Edmonton at www.edmonton.ca or call 311.

Selecting the New Heating System

When purchasing a new heating system, keep the following points in mind to help ensure the unit you purchase will be as efficient as possible and properly suited to your needs.

- **Properly insulate, caulk and weatherstrip your home before purchasing a new space heater.** If you make your home as energy-efficient as you can, your heating requirements, and therefore the size and cost of your heating system will be significantly reduced. See the *Home$avers* booklets on *Attic Insulation*, *Basement Insulation* and *Caulking and Weatherstripping* for more information.
- **Closely compare various units.** There are a wide variety of furnaces available. Compare energy-efficient features, seasonal efficiencies, installation and operating costs, ease of maintenance, availability of parts, service policies and warranties.
- **Avoid oversizing.** Existing furnaces are often oversized, especially if you have weatherized your home. Properly sized, your heating system will run more efficiently and provide greater comfort.
- **Look for hidden costs.** A quote to replace a gravity system or older conventional furnace with a newer forced-air model may not include plumbing changes, concrete to fill the hole in which the furnace was sitting, removal of an old cast iron unit or changes to duct work.

There is a large selection of high-efficiency furnaces, boilers and combination units available. Quoted efficiencies vary widely, as do prices. Generally, as the efficiency of the heaters increase, so does the cost.

Considering the current cost of natural gas, the likelihood of ongoing price increases and the need to reduce GHG emissions, the extra costs for a high-efficiency furnace is a worthwhile investment in almost every case.

Sizing the Heating System

Your new heating system must be properly sized in order to operate efficiently. **Older equipment has often been oversized by at least 10 to 20% (sometimes as much as 100%), especially if you've air sealed and upgraded your home's energy efficiency.**

The more oversized it is, the less time it spends operating at or near peak efficiency. As a general rule, during the coldest winter days, if the furnace is frequently off, it is a pretty good indicator that your present heating system may be oversized.

A properly sized unit will run almost constantly during the coldest day of the year. It is then operating at peak efficiency and giving you maximum value for your heating dollar. You can see however, that even a properly sized heater will have more capacity than necessary for most days of the year when it will operate at less than peak efficiency.

A qualified heating contractor can properly size a new heating unit for you, or, if you would like to size a new furnace yourself, CMHC offers a furnace sizing program on their website (see “Additional Information” at the back of the booklet for CMHC’s website link and use the search function to find the resource).

Be sure that any of the following changes to the house are taken into account:

- Increased insulation levels in the attic, walls and basement.
- Reduced air leakage due to weatherstripping and caulking.
- Upgraded windows and doors.
- Completed or planned additions to the house.
- Heater performance and house comfort with the old unit.

Know the size of your existing system. The “input” and “output” amounts are stamped on an identification plate inside the furnace access door (Figure 5). The size is usually

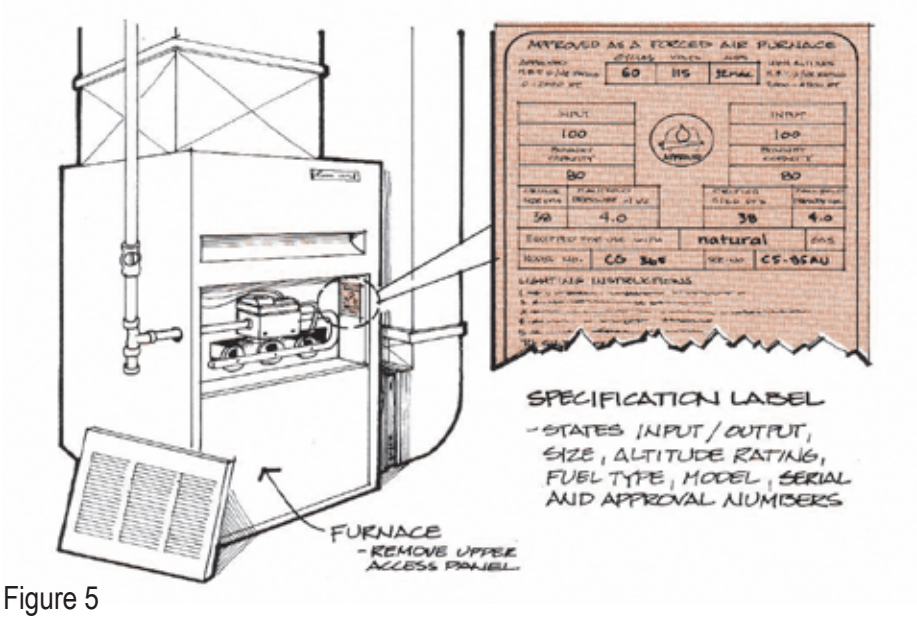


Figure 5

measured in British Thermal Units per hour (BTU/hr) or the metric equivalent of kilowatts (kW). The furnace “output” amount should be sized to the heat load of your house, not the “input” amount. Two furnaces with different efficiencies can have the same “input” amount but will have different “outputs”.

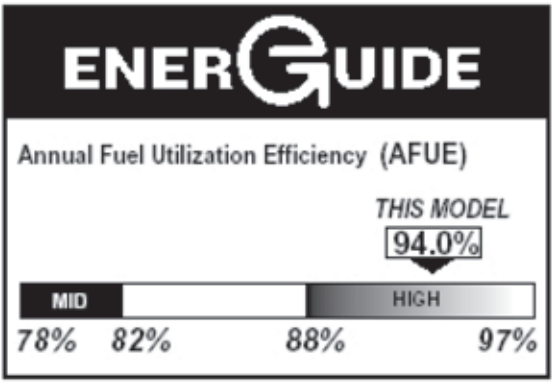
Furnace Efficiency Ratings

Look for the EnerGuide label to determine the efficiency level of a gas furnace or boiler. Check the EnerGuide rating on the back page of the manufacturer’s brochure – the higher the rating, the more efficient the model.

Check where the EnerGuide rating is situated on the scale to see if the furnace you are buying is in the high-efficiency zone.

Annual Fuel Utilization Efficiency (AFUE) is a universal rating system established by the Government of Canada to assist consumers in comparing different models of residential furnaces.

All furnaces should have an **EnerGuide Label**, which rates furnaces using an AFUE



number. The AFUE number is essentially a measure of seasonal efficiency or how efficient a furnace is over the entire heating season.

For example, a furnace with an AFUE rating of 94% indicates the unit will provide 94 cents worth of heat for every dollar of fuel consumed.

You should also look for the ENERGY STAR® symbol, which can usually be found on the furnace, the packaging, on the EnerGuide label or in promotional literature. Only the top energy performers are eligible to use the ENERGY STAR symbol – residential gas furnaces must have an AFUE rating of 90 or higher to qualify.

To qualify for government rebates, high-efficiency furnaces need to have a higher AFUE rating. Please refer to NRCan and Climate Change Central (contact information is provided at the end of this booklet) for current qualifying criteria.

You may see the ENERGY STAR symbol displayed in various ways.

If you are purchasing a new furnace, be sure to have the contractor explain the choice and sizing of units to you. Simply guessing or duplicating the size of your old unit will rarely give you an efficiently-sized heating unit.

If modifications to ductwork, alterations to the floor drain or electrical changes are necessary the cost of installing a new furnace may be even higher. There may also be a size restriction if the original space is too small.

It is essential that you have a **qualified heating contractor** do the installation work following the requirements of the **Alberta Building Code and Gas Code**.

Radiant and Convective Systems

A number of space heating systems rely on radiation and convection to distribute heat. The most common is the hydronic or hot water type. Modern systems use a boiler and a circulation pump to quickly move a small volume of 80ºC (180ºF) water through smaller finned convector radiators (Figure 6).

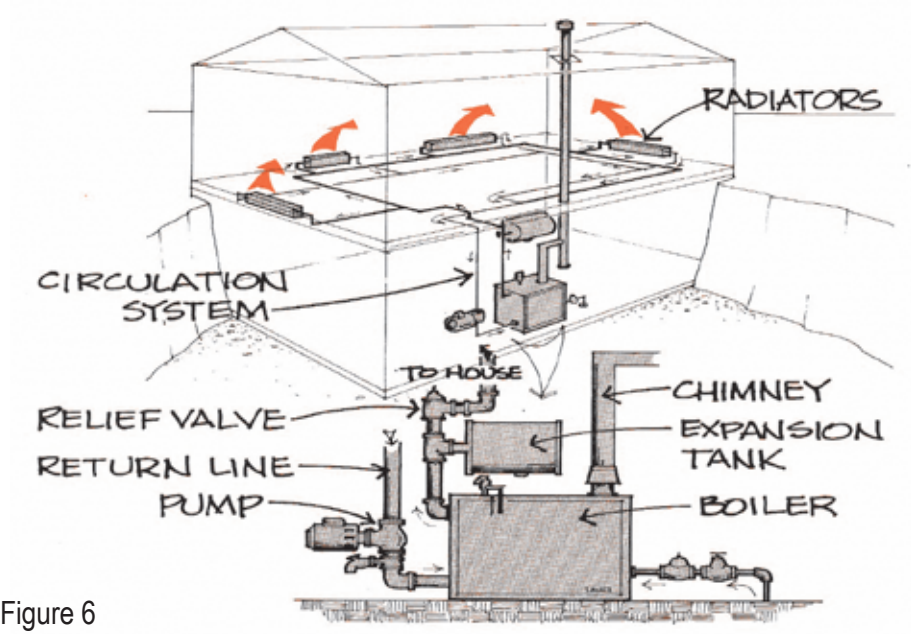


Figure 6

Hot water (usually a mixture of water and ethylene glycol) is generated by a boiler using natural gas. Conventional boilers have seasonal efficiencies of 60 to 65%. Mid-efficiency boilers draw combustion air from the outside with seasonal efficiency of 70 to 80%. High-efficency units have seasonal efficiencies of 85% and higher. Residential gas boilers sold in Canada today are required to have an AFUE rating of at least 80%. All boilers require yearly maintenance and servicing.

High-efficiency boilers must have an AFUE rating of 85% or higher to qualify for the ENERGY STAR symbol. Like furnaces, boilers must have a higher AFUE rating to qualify for government rebates. Please refer to NRCan and Climate Change Central (contact information is provided at the end of this booklet) for current qualifying criteria.

These systems use smaller pipes and radiators than the older systems. When considering conversion, additions or replacement, ensure all components of the old and new systems are compatible.

Adjusting the operating temperature, either manually or with a controller, to reflect the house's demand for heat and the outside temperature can increase system efficiency. It is also possible to zone control areas of the house to provide better control and help further reduce costs.

Radiant floor heating is another hydronic system. Usually found in newer homes, it circulates hot water from a boiler through tubes embedded in the concrete basement floor and between the floor joists of the upper levels (Figure 7).

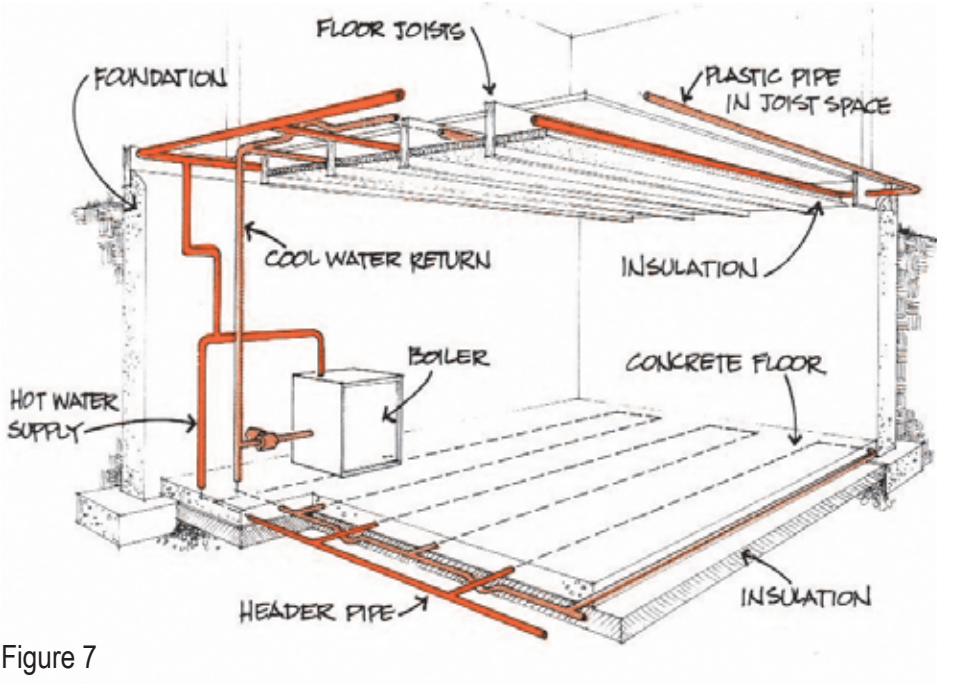


Figure 7

It is wise to insulate below the concrete floor slab to prevent heat loss to the ground. Theoretically, the system provides the most comfort as it keeps the floor warm while maintaining a cooler temperature at head level. Heat transfer into the house is most effective when floors are tiled or lightly carpeted.

Homes heated with radiant in-floor heating require the installation of a whole house ventilation system. These systems are required to ensure a supply of fresh air is maintained and distributed through the home. Additional information on home ventilation systems is available in the *Home$avers – Ventilating Systems* booklet.

Other Systems

Combination hydronic and forced air systems offer another alternative high-efficiency system. In one type, a high-efficiency boiler supplies hot water to a heating coil in the air plenum (Figure 8). Air, forced past the heating coil by a fan, is heated and distributed as in a forced-air system.

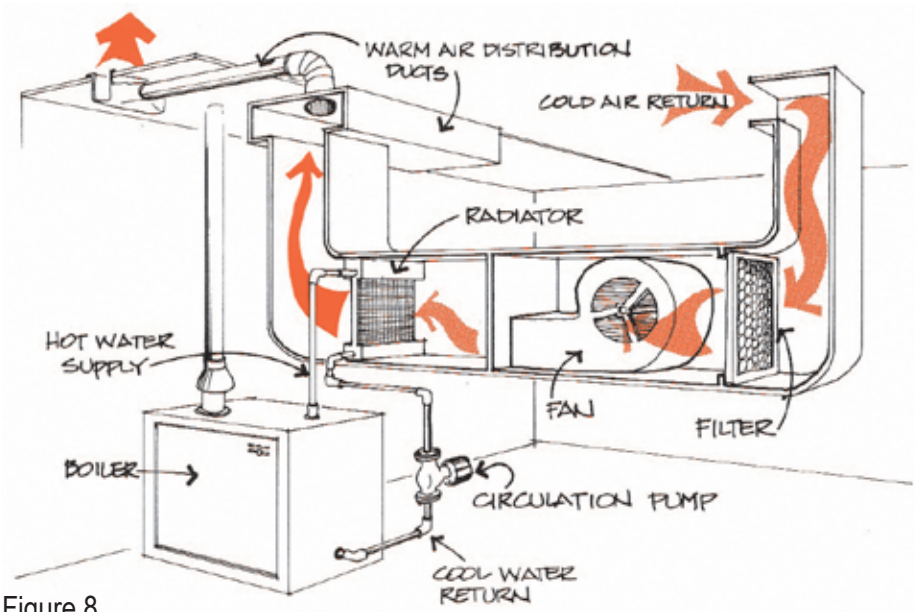


Figure 8

The boiler can also heat a hot water tank (the tank would not need its own combustion unit) further reducing fuel usage, costs and GHG emissions while greatly increasing overall system efficiency.

Ground Source heat pumps are available that are extremely efficient and also provide air conditioning. Ground source heat pumps are electrically powered and can be used for hydronic or forced air heating systems. Unfortunately, these systems are more expensive and require coils or long runs of underground piping as the heating and cooling source, which limits their use on small urban lots. The use of electricity to run the pump currently limits their potential for reducing GHG emissions.

Electric furnaces are of similar design to gas-fired units, but use electric elements to heat the circulating air stream. The units are 100% efficient as combustion inefficiencies and chimney losses are eliminated.

Although less expensive to purchase, very few homes use electric furnaces or electric duct heaters due to the historically higher cost of electricity compared to natural gas. This may change as the cost of natural gas continues to increase.

Electric baseboard or ceiling heating systems, normally consist of individually controlled modules. Electric baseboards rely on convection (movement of warm air) to distribute heat. Ceiling panels rely on radiation (heat waves). Electric radiant wall mount pictures are also available which add a decorative touch for supplemental radiant heating.

Although fairly reasonably priced and reliable, electric radiant home heating systems also require a separate ventilation system and are not popular home heating systems.

Airtight woodstoves and fireplace inserts can be effective space heaters in small, well-insulated homes or in large open areas where air circulation is good. There are two common types, radiant stoves and circulating stoves. The radiant stove heats energy from its hot surface and relies on convection currents in the room to distribute the heat.

With a circulating stove, the hot surface is encased in a vented metal shell and air is circulated by natural convection or a fan. A central location will increase the effectiveness and heat distribution of the stove.

Modern woodstoves have airtight doors and an outside combustion air inlet. The rate of combustion, and thus the heat output, is controlled by adjustable draft controls or by thermostatic controls, and efficiency ratings up to 70% can be achieved.

Correctly sizing the unit is important. As a general rule, think small. An oversized stove produces too much heat and the tendency will be to operate the stove at low combustion rates. This causes tar-like and inflammable creosote deposits to form in the stovepipe and flue.

If the unit is too small, frequent over firing may result in safety problems. Know the dimensions and insulation levels of the area you need to heat and have an experienced wood-heating retailer assist you in selecting an appropriately sized heater.

Be sure the woodstove is certified to Canadian Standards (CSA), is a high-efficiency unit with low particulate emissions (EPA certified) and that the installation meets all local building codes and fire safety regulations.

Manufacturer's recommended clearances to combustible materials must be strictly adhered to.

Maintenance

Safety

Family and personal safety is the primary reason for regular heating system maintenance. Remember for safe operation, fuel-fired appliances need a combustion air supply and must be properly vented to a chimney.

Visually inspect the vent connection pipes from the furnace, boiler and gas-fired water heater to the chimney (Figure 9). Check that all the joints are tight and securely fastened. Look for any rusted or "soft" spots in the pipes because harmful gases such as carbon monoxide may leak in through holes or gaps. Replace deteriorating pipes immediately. The top of the metal chimney should also be inspected periodically for deterioration.

Masonry chimneys must have metal or ceramic liners when used for exhausting gas appliances. Visually inspect the chimney lining with a mirror in the cleanout access, and check for blockages. Make sure all openings, except those servicing the furnace and hot water heater, are closed off. This includes openings previously used for a kitchen range or gas space heater.

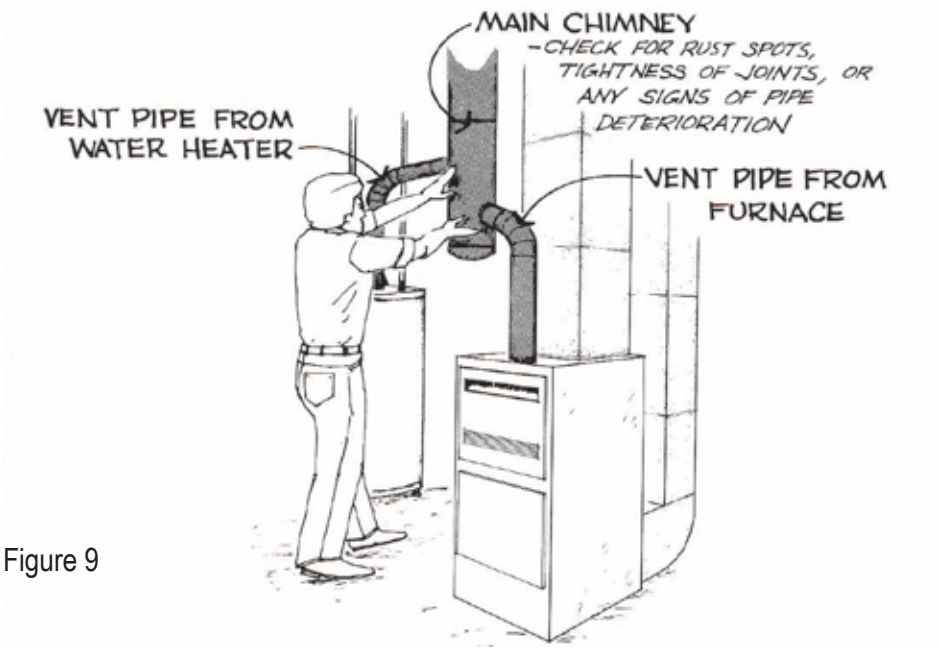


Figure 9

Signs of excessive carbon or rust deposits, escaping fumes or irregular flame patterns should be reported immediately to your gas company. **If there is gas odour, evacuate and ventilate the area. Avoid flame or electrical spark sources (e.g. light switches) while waiting for the utility company representative.**

Check for obstructions that reduce the combustion air supply to the furnace and hot water tank. It is important not to store anything close to the furnace or hot water tank. Be sure these units are not enclosed in a small area without an air supply. Never operate them with any access panels removed.

Because houses are now sealed better, a shortage of combustion and draft air may result. **This causes combustion gases to be drawn back into the house, called "backdrafting".** Exhaust fans, fireplaces, woodstoves and clothes dryers can further aggravate the problem. If you smell combustion gases near the furnace or hot water tank, or if a fireplace does not draw properly unless a window is open, backdrafting can be occurring. **Backdrafting is a serious health hazard and should be remedied immediately.**

Alberta Building Codes now require that a combustion air inlet be installed for any gas fuelled units. A separate duct is required to bring combustion air to the furnace and hot water tank from outside (Figure 2). This duct cannot have a manual damper and must be located within one foot vertically and two feet horizontally of the burners on the largest appliance, usually the furnace. To avoid the unwanted dumping of cold air, the combustion air duct needs to be equipped with an approved automatic damper.

The size of the combustion line depends on several things including appliance rating and house construction. Consult the gas inspector, furnace contractor, local inspector or the provincial inspection authority to determine the proper sizes for the ducts.

System Maintenance

Most area homes are heated with a natural gas forced air or hot water heating systems. Maintenance of different systems follows, but one common requirement is the need for fresh air for combustion and for proper chimney operation.

A lot of heat produced by a conventional furnace is lost up the chimney. This is necessary in order to properly vent combustion products.

Adding reclaiming devices to the flue to recover this heat is not only illegal but also dangerous. It can cause water vapour to condense in the chimney causing corrosion. The condensation could also freeze and block the chimney in cold weather.

Newer mid- and high-efficiency furnaces are designed to safely recover the maximum amount of heat possible from the flue gases.

Forced Air Systems

Furnaces or boilers should be **professionally inspected and tuned up** prior to each heating season. Proper and efficient operation also depends on unobstructed airflow through the furnace's air circulation system (Figure 10).

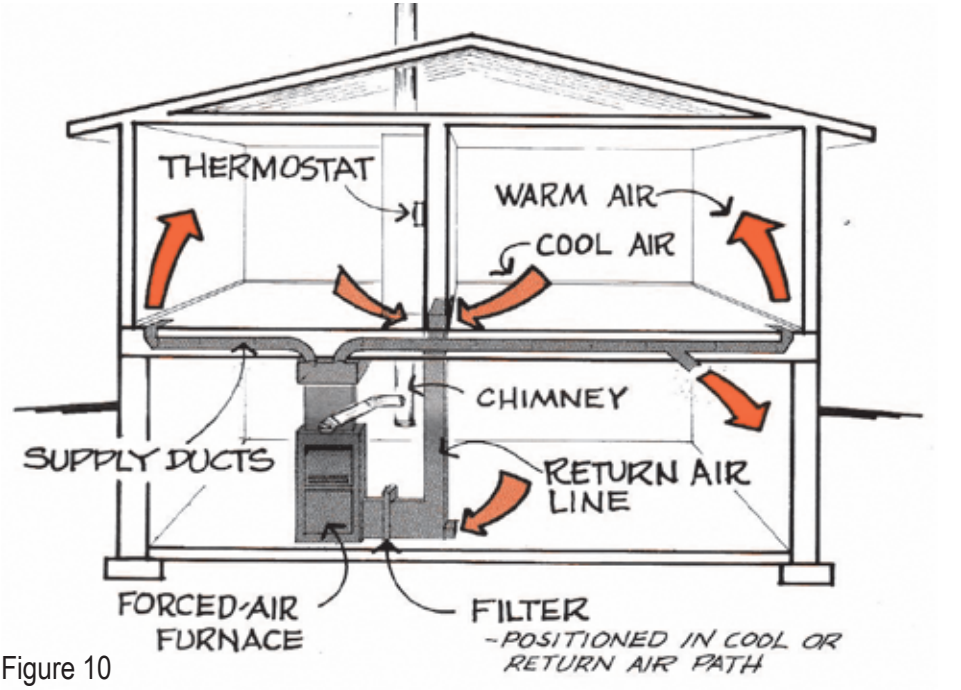


Figure 10

The easiest and most effective way to achieve this is to keep the filter clean. If the filter becomes clogged and dirty, air movement slows and efficiency drops because heat is not removed from the heat exchanger fast enough. Reduced airflow also results in poor heat distribution, especially in rooms furthest from the furnace. **Simply changing or cleaning your furnace filter monthly during the heating season can reduce fuel usage, maintenance costs and GHG emissions from 2 to 3% a year.**

The most common styles of filters are shown in Figure 11. Disposable filters of cardboard and fibreglass should be changed monthly during the heating season. Permanent filters should be cleaned monthly by vacuuming or washing.

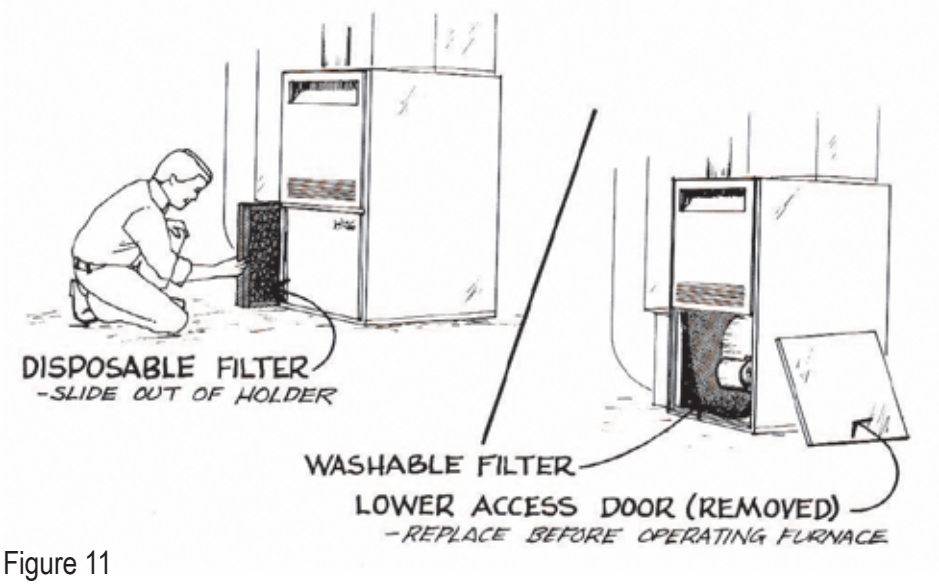


Figure 11

Other types, such as electronic or charged media, should be maintained as specified by the manufacturer. Usually, they will require monthly cleaning during the heating season.

Keeping the entire duct system clean will prevent the filter from clogging frequently. Remove the register (diffusers) and vacuum the duct as far as you can reach. You may need to hire a commercial furnace cleaning service for heavier amounts of dirt lodged in the ducts. Cleaning services that use chemical-free processes are available.

Airflow also depends on the condition of the motor and blower. Lubrication of the blower motor bearings should be the only maintenance required. **Turn off power to the furnace and then remove the lower access panel to the motor and blower assembly.** Twice a year, add two or three drops of non-detergent electric motor oil to each oil port (Figure 12), more often if the fan is running continuously.

Note: If there are no oiling ports visible, the motor and blower have sealed bearings and require no lubrication.

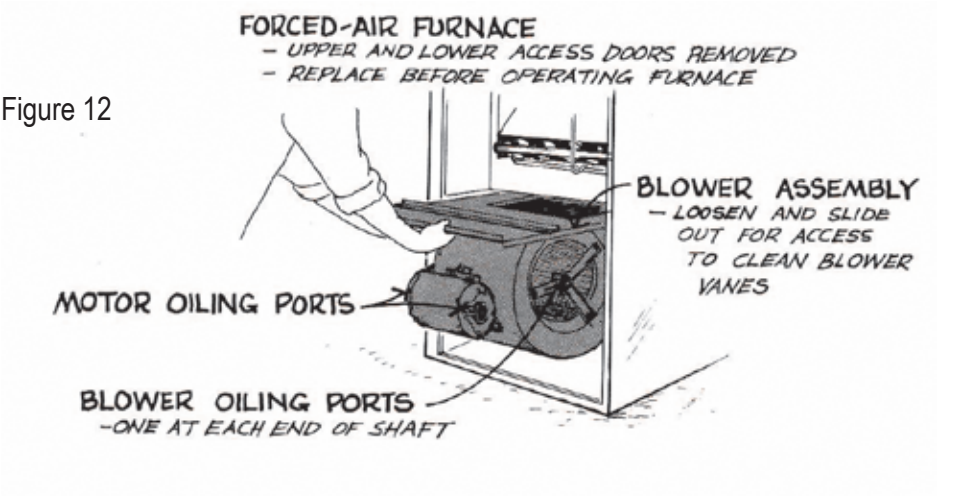


Figure 12

If the fan is not directly driven (with the motor mounted inside the fan assembly), check the belt drive between the motor and blower fan. Proper tension is set by changing the angle of the motor. There should be 20 to 30 mm, (¾ to 1¼ inches) of slack in the belt midway (Figure 13).

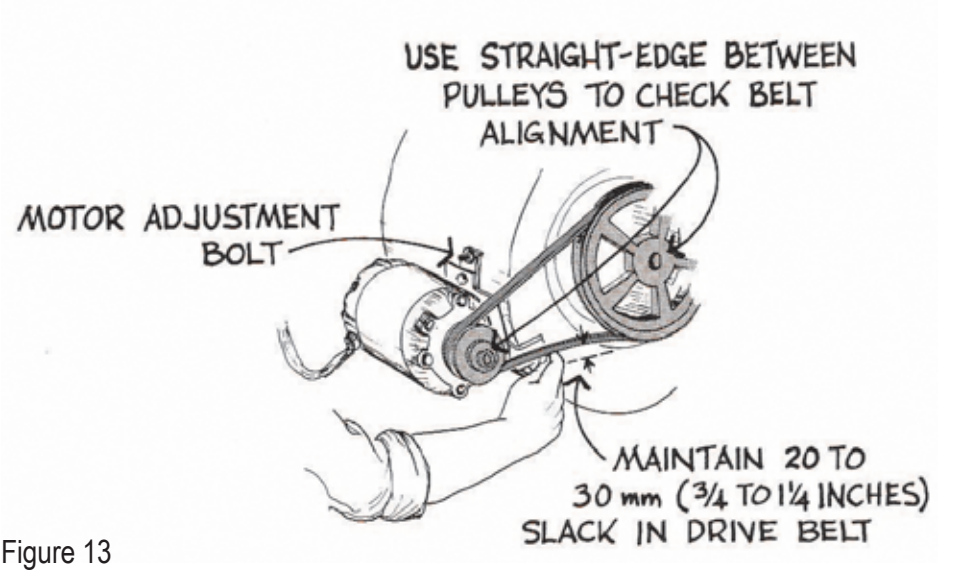


Figure 13

Examine the belt condition and alignment. **Make sure the power is off.** If the belt is cracked, frayed or worn replace it. Loosen the motor, remove the worn belt, install a new one of the correct size and adjust to the proper tension. Use a straightedge or look along the belt to see that the pulleys are lined up correctly. If pulleys are not aligned, loosen the motor pulley, slide it along on the shaft and then retighten the pulley. Keep a spare fan belt for emergency replacement.

When the lower access panel of the furnace is off, take a look at the blower vanes. Soil build-up on the vanes will impede efficient operation and air flow. Loosening a few bolts will usually expose the assembly enough to scrape and vacuum the blower vanes.

To completely clean the blower, remove it entirely, disconnect the motor and wash the blower at a coin operated car wash. This removes built-up grime on the vanes. Remount the blower/motor assembly, replace the lower access door and turn the power on.

Do not operate the furnace without all access doors in place.

Older Gravity Systems

Gravity furnaces have no fan to move the air. The action of heated air rising and cooled air falling circulates heat from the furnace through the home. The major concern for gravity system air flow is to keep the ducts clean and unobstructed.

It is important that both supply and return ducts are free of any dirt build-up and that no furnishings or drapes block the grilles. Gravity systems usually rely on thermostats for temperature control, so lowering temperature settings at night will still save energy.

Gravity furnaces are quite old so the heat exchangers should be checked to ensure that they are not cracked or leaking and are still safe.

If your home still has a gravity furnace you should be seriously considering upgrading to a high-efficiency unit as soon as possible.

Hot Water (Hydronic) Systems

The layout of a typical residential hot water heating system is shown in Figure 6. There are various systems (series loop, one pipe, two pipe, etc.) but most rely on a circulating pump to move water through baseboard convectors or in-floor heating pipes.

A minimum amount of maintenance is required for most hydronic heating systems. Usual service requirements include bleeding air from the system, maintaining the water level and occasionally adding corrosion inhibitor as per manufacturers' recommendations.

Procedures to add water and remove excess air vary among systems. Consult service manuals or a qualified heating contractor.

If the motor does not have sealed bearings (Figure 14), it is important to lubricate the circulating pump twice a year. Place a few drops of non-detergent electric motor oil into the oil cups at both ends of the motor and on the top of the bearing assembly between the motor and pump body.

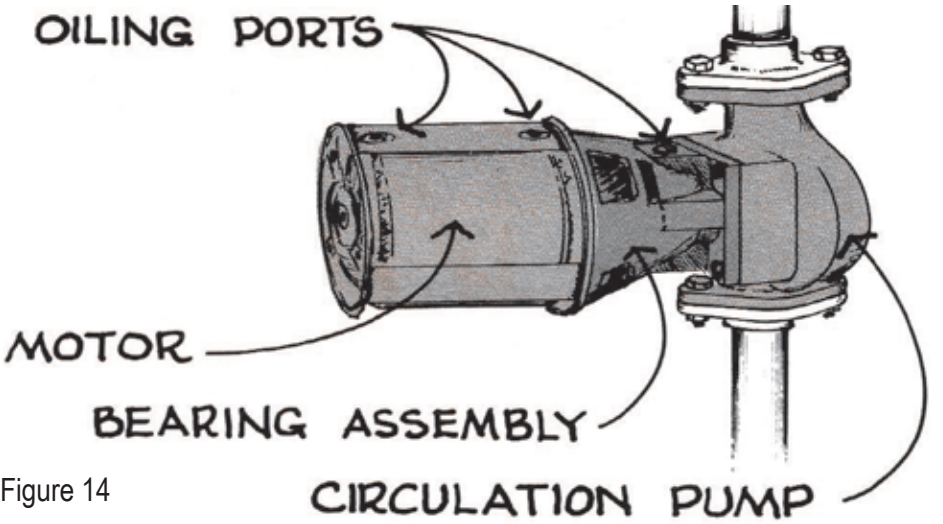


Figure 14

Choosing a Heating Contractor

If you are considering replacing your current heating system with a new higher efficiency unit, you will probably need to hire a qualified heating contractor for the installation.

Ensure that your heating contractor is fully qualified to install and maintain the new high-efficiency units. Consider the following suggestions:

- Collect names of contractors from friends and neighbours who have had a new furnace installed recently. Ask if they were pleased with the installation and service work. Check which furnace they had installed and ask how it is functioning.
- Determine the expertise of the contractor by asking about the differences between mid- and high-efficiency heating units, the economics involved in purchasing each, the advantages of various features and how they operate.
- If possible obtain at least three written cost estimates from different contractors, suspect any that vary too much for an equivalent job. Details should include total price plus a labour and material breakdown, type of equipment to be installed and warranties. Remember, it is worth paying a little extra for a proper installation.
- Before selecting a contractor, ensure the firm is bonded, has a provincial licence and is adequately insured. You may also want to find out how long the firm has been in business by calling the Better Business Bureau. Check with the local utility about the work to be done to ensure all heating and ventilating codes are being satisfied.
- Ensure that the contractor obtains all necessary permits and inspections.
- Inspect the job before the contractor leaves and before making final payment. Check that all vents to the outside have been properly air-sealed.

No amount of advice will ensure a perfect installation, but by asking the right questions before, during and after the job you will help to ensure a proper and high quality installation.

High-Efficiency Equipment

High-efficiency furnace and boiler technologies are available from a variety of companies and have undergone many changes and improvements in the last few years. You can find the full list of manufacturers of high-efficiency furnaces and boilers on the Energy Star website: furnaces - http://www.energystar.gov/index.cfm?c=furnaces.pr_furnaces; boilers - http://www.energystar.gov/index.cfm?c=boilers.pr_boilers

Heating System Design for New Housing

For a heating system to provide a high level of comfort at an affordable price, its design, selection and installation must be given proper consideration when the home is being planned. Although forced-air systems are used in most local homes, radiant heating systems with whole house ventilation systems provide a high degree of comfort and offer certain advantages. A comparison of these systems is provided in the table below.

Once the system is chosen, select a qualified heating contractor to ensure that the equipment is properly sized and installed, and that provision has been made for adequate combustion and make-up air to the heating unit.

Forced-Air	Radiant
Advantages Forced circulation provides fresh air throughout the home. If the furnace has a multi-speed fan, the low speed can be used year round to maintain humidity and fresh air. Humidifier easily incorporated. Using low fan speed, solar gains and heat from lights, appliances, etc., can be distributed. Air can be filtered easily, widely used and easily serviced.	**Advantages** No drafts from forced air circulation. Provides high degree of comfort. Piping easily installed and concealed. Low maintenance. Clean and quiet. Individual room control possible. Even temperature distribution. Domestic hot water supply can be tied into system. Takes less room for equipment installation.
Disadvantages At least annual servicing required. Filter requires monthly inspection / replacement. Noise levels are higher. More drafts. Large ducts and furnace use lots of space when finishing a basement.	**Disadvantages** Possible water leaks. Heat distribution difficult, especially solar and internal heat gains. Baseboard heaters interfere with decorating. Expensive to add air conditioning. Difficult to humidify air. More expensive. Requires installation of a whole house ventilation system.

Additional Information Sources

Natural Resources Canada – Office of Energy Efficiency

www.oee.nrcan.gc.ca – The Office of Energy Efficiency offers a wide range of free publications, programs and services to help Canadians save energy and reduce the greenhouse gas emissions that contribute to climate change.

Recommended Reading: *Keeping the Heat In* is a comprehensive source of energy efficiency how-to information for residents. This free publication is available from Natural Resources Canada. Call toll free at **1-800-635-7943** or download it from **http://publications.gc.ca/pub?id=259273&sl=0**.

Canada Mortgage and Housing Corp.

www.cmhc.ca – CMHC is a valuable resource for information. The CMHC Order Desk is a one-stop shop for all free and priced publications, fact sheets, reports, videos and other CMHC resources. You can order online, or through their call centre at **1-800-668-2642**.

EPCOR

www.epcor.ca – The website contains information on energy and water efficiency with calculators, tools and downloadable publications to assist you in reducing your energy and water consumption.

Tools include a ***Home Energy Audit****,* a do-it-yourself home audit with a library of resources; ***EPCOR House***, an animated tour of a typical home with efficiency information; and calculators for most major appliances, plus a ***simple electricity calculator*** and ***water audit tool***. Tools are located in the EPCOR-Customer Service drop down menus.

Environment Canada

www.ec.gc.ca – Environment Canada's website provides weather and environmental information to help connect Canadians, exchange information and share knowledge or environmental decision making.

Climate Change Central

www.climatechangecentral.com - Climate Change Central has information and resources to help Albertans save energy and reduce the greenhouse gas emissions that contribute to climate change.

Notes:

Notes:

Become A CO_2RE Member

We all contribute to the problem of Climate Change and each of us can contribute to the solutions. Become a CO_2RE Member. Membership is free and you can sign up on the CO_2RE website at www.edmonton.ca/co2re.

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Carbon Dioxide Reduction Edmonton

Publications Currently Available

- Attic Insulation
- Basement Insulation
- Caulking and Weatherstripping
- Condensation Concerns
- Conserving Electricity
- General CO_2RE Brochure
- Heating Systems
- Renewable Energy
- Ventilating Your Home
- Water Conservation
- Windows
- Eco-Landscaping Brochure

THE CITY OF Edmonton

Deputy City Manager's Office
Office of Environment

Suite 750, Tower I Scotia Place

10060 Jasper Avenue NW, Edmonton, Alberta T5J 3R8

Phone: 311 (in Edmonton) / 780-442-5311 (outside Edmonton)

Website: www.edmonton.ca/co2re