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# BOUT YOUR HOUSE

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## REPLACING YOUR FURNACE

There are usually two major reasons why you are choosing another forced-air furnace. The first is that your furnace does not function. It has just broken down, irrevocably, or it has been “red-tagged” or condemned by gas inspectors. If it is winter and your house is getting colder quickly, you may not have the luxury of making a reasoned choice on what to buy next. The other situation is that your furnace is getting old, or your fuel bills are becoming too excessive to tolerate. In this case, you have the time to shop around and get the best furnace and fuel for your situation.

This “About Your House” is written for both situations. If you have a dead furnace and a chilly house, you will probably take some shortcuts in your selection process.

### Choice of fuels

For many years, CMHC and others could offer sound advice on what fuel choice would be the most economical. During that period, heating systems based on electricity or propane cost the most to operate, heating oil was somewhat more economical, and natural gas (if available in your community) was the least expensive choice. Since 2000, the prices of these commodities have been fluctuating wildly, and it is difficult to offer reliable advice on pricing. At one point in 2001/2002, heating with electricity in Manitoba was as economical as the natural gas option. Predicting these prices over the next two decades (a common life span of a furnace) is nearly impossible. The best

advice is to make a calculation based on the current prices quoted to you in your locality. See the sidebar.

### Furnace sizing

You probably do not need a furnace with the output of your current furnace. Most furnaces in Canadian houses can provide far more heat than the house requires. A properly sized conventional or mid-efficiency furnace will be running almost continuously during the coldest day of the winter. Having a furnace of a correct size will result in efficient operation during the whole heating season. A grossly oversized furnace will run only for a short period, never coming up to peak efficiency. Note, however, that sizing may not be an issue with high-efficiency, condensing gas furnaces. Due to the design of condensing appliances, they are efficient even when oversized.

So, how do you size your furnace? You can have the contractor use a home heat loss calculation that is available from Canadian Standards Association (CAN/CSA F280) or a sizing procedure from the Heating, Refrigeration, and Air Conditioning Institute of Canada (HRAI). Having a proper sizing will cost you \$150-\$300 from a qualified contractor.

For those who keep their heating bills, and who are mathematically inclined, try the calculation in the sidebar entitled “Calculating house heat loss from utility bills”.

### Furnace efficiency

There is a wide range of furnace efficiencies, although the conventional, standard-efficiency gas furnaces can no longer be sold in Canada. The range of efficiency will vary by fuel as well.

Electric furnaces work on electric resistance. The full 100 per cent of the energy consumed goes towards the heating of the house. The inefficiencies with electric heating happen before the electricity reaches your house. If the electricity is created by burning fuels, there is an inefficiency in that process plus losses as the electricity moves through the lines.

Oil furnaces have become far more efficient since the height of their popularity in the mid-twentieth century. Efficiencies have risen from roughly 60 per cent to well over 80 per cent due to advanced technologies, first to flame retention head burners and then to high static pressure burners. The more efficient oil furnaces require a better chimney than their conventional counterparts, so you will probably need to upgrade the chimney with a stainless steel liner inside the old clay tile. Make sure this is included in the quote. Failure to have a properly sized chimney will result in excessive



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chimney condensation and eventual destruction of masonry chimneys. There are high efficiency, condensing oil furnaces as well. They are not currently recommended by Natural Resources Canada in their publication "Heating With Oil" due to problems with reliability.

New gas furnaces in Canada can either be mid-efficiency (78-82 per cent) or high efficiency condensing furnaces (89-96 per cent). The high efficiency furnaces use a plastic vent and are most often vented out the side wall. Most mid-efficiency furnaces still use a metal chimney approved for gas appliances (B-vent) or a stainless steel liner inside an existing chimney. Propane furnaces are usually modified natural gas equipment. The NRCan publication "Heating with Gas" suggests that you do not buy a mid-efficiency gas furnace that is too efficient (e.g. over 82 per cent) due to problems with condensation in the furnace or venting system.

## So . . . what do I buy?

Here are the most common questions about furnace replacements to CMHC staff from Canadians, and our usual answers:

### *1. Should I switch my heating fuel?*

In most parts of Canada, it will be more expensive to heat with an electric furnace than one with oil or gas. An exception would be if you heat primarily with a woodstove and use the furnace only infrequently as backup. In this case, the low cost and low maintenance requirements of an electric furnace may be a major advantage. Choosing between oil and gas furnaces is a matter of choice. Make the calculation (see sidebar) to see if it is significantly cheaper to use one fuel or another based on current prices in your area. Oil furnaces require a tank and usually a chimney. There may be additional costs for chimney modification or oil storage tanks when purchasing an oil furnace. Some home insurance companies require periodic oil tank replacements. Check if a new gas furnace would also require relining the chimney. Consult with your contractor and make sure that these costs are included in your estimates.

### *2. Some dealers are recommending a furnace of 100,000 BTU/h and some say 80,000 BTU/h will be fine. How do I choose?*

See the discussion on sizing above. If you are buying an oil furnace or a mid-efficiency gas furnace, proper sizing will affect the durability and efficient operation of your appliance. Your choices are either to pay for a proper heat loss analysis, calculate house heat loss, or accept the dealer's estimate. Sometimes government or utility programs subsidize house testing, such as the NRCan Energuide for Houses tests. If such a program is in effect in your vicinity, this can be an economical way to have your house heating load established.

### *3. Is it better to buy a high efficiency or a mid-efficiency gas furnace?*

Surveys in the last several years show that the incremental cost to purchase a high efficiency gas furnace over a mid-efficiency model is in the order of \$300 to \$1,000. Given the gas prices through the 1990s, this price increase would take five or more years to pay back through the lower operating costs of high efficiency furnaces. As natural gas prices increase, it becomes increasingly easier to recommend high efficiency appliances. Other reasons for choosing high efficiency appliances include their lack of chimney, their ability to operate safely in newer, airtight housing (where chimney performance can be affected by negative pressures), and the apparent longevity of their plastic venting systems.

### *4. Is Furnace "A" better than Furnace "B"? How can I find that out?*

There is little or no available data to show that one manufacturer's furnace will operate longer and with less trouble than a furnace from another manufacturer. This is frustrating for consumers. We are used to being able to read ratings of one product versus another product and to make a choice based on those ratings. However, a good furnace will last 25 years. A poor one may break down prematurely at 15 years. With lifetimes of this length, and with furnace design and model changes, it is hard to predict which furnace will provide the best service.

There are two factors to help you in your choice. Pick a furnace with a long heat exchanger warranty, 20 years or more. If the manufacturer is willing to back the most expensive part of their appliance for a long time, this should inspire some confidence. Also, pick a furnace manufacturer and a dealer that have been in business for a significant period of time. A furnace with a lifetime warranty offered by a company which has been in operation for only three years may not be the best deal. One would expect to pay less for this level of uncertainty. Look for contractors with memberships in trade organizations such as HRAI, which would indicate an interest in professional qualifications.

## The hot water heater conundrum

There are very few high-efficiency hot water heaters available. Changing your furnace may lead to having to think about your hot water heater. Existing hot water heaters are often located vertically below the kitchen and bathrooms, where the water is used. If you are changing from an electric to a conventional gas hot water tank, and the new gas appliance has to move across the basement to be near the chimney, you will be waiting longer for the hot water at the tap. Consider a gas hot water tank that has sidewall venting, and does not require a chimney. This way it can stay close to the plumbing appliances that use it.

Another hot water tank issue is when you switch from a conventional gas furnace and hot water tank to a new, high-efficiency sidewall vented furnace. Now the hot water tank has to heat up that big chimney all by itself, and you probably will have to pay for chimney relining. It is often better, when choosing a chimneyless furnace, to switch your hot water tank to sidewall venting at the same time, and seal the old chimney closed. However, sidewall vented hot water heaters are more expensive than conventional hot water heaters and can be noisier.

## Furnace circulating fan choices

Most furnace circulating fans consume high amounts of electricity (300-700 watts). If you will be using your furnace circulating fan to move ventilation air around the house (for instance, if you have a heat recovery ventilator connected to it, or a high efficiency air cleaner on the furnace), then look at upgrading the circulating fan to a high efficiency DC motor. The best furnace fans now will use less than 100 W on low speed. This will result in considerable electrical savings over the life of the furnace.

## Other choices

When replacing the furnace, you may want to look at integrated systems that heat your house, your water, and provide ventilation. Devices known as "combo" units provide house and water heating. New appliances with advanced, integrated systems will provide ventilation as well as space and water heating. For some replacements, these integrated appliances will be your best choice.

For further detailed information on all heating appliances, there are excellent booklets published by Natural Resources Canada in the Home Heating and Cooling Series, some of which are cited in this About Your House. These can be obtained from NRCan or viewed on the NRCan Web site at: [http://energy-publications.nrcan.gc.ca/index\\_e.cfm](http://energy-publications.nrcan.gc.ca/index_e.cfm)

## Calculating house heat loss from utility bills

Here is a sample calculation, using the a three-month meter reading for a typical house. You can use any period (but at least two weeks of winter weather is necessary). You can either read the meter yourself for the information, look at your furnace bills, or phone your utility to see if they have appropriate records. The natural gas usage of other gas-fired appliances in the houses is estimated from gas utility data and subtracted from the total for the period in question, so that the gas requirement for heating could be isolated. (Oil furnaces are harder to size using this method but it may be possible using oil fill-up intervals and the number of litres delivered.)

The goal is to find a relationship between the gas consumed and the heating degree days (HDD). A heating degree day is essentially the number of degrees of heating required over the course of 24 hours, and is compared to a reference temperature of 18°C. For example, if the average daily outside temperature is 10°C, then the number of heating degree days for that day is 18°C - 10°C = 8 HDD. The HDD are available from Environment Canada data. You can get the approximate HDD for that period from their Web site at: <http://dd.weatheroffice.ec.gc.ca/climate/monthly> Summaries or you can find the exact heating degree days for your billing period by calling the Environment Canada pay-for-use number 900 565-5555, where it will cost you \$3.00 - \$6.00 for the information. Once the relationship of the HDD and gas consumption is established, then you can calculate gas consumption for design temperature in your area, which is usually available from Environment Canada, a mechanical contractor, or your local building officials. You substitute this into the equations

below. The example uses a Saskatoon design temperature of -35°C (which works out to 35°C + 18°C = 53°C). Calculating the size of the furnace necessary on the coldest day of the year will mean that the furnace has the capacity to handle any expected local temperature.

### Example:

Total gas consumption December to March = 1,320 m<sup>3</sup>

Estimated consumption for other gas appliances (data from utility) = 306 m<sup>3</sup>

Therefore, gas consumption during the period for heating = 1,320 - 306 = 1,014 m<sup>3</sup>

Heating degree days for that period (from Environment Canada data) = 2,840 HDD

Heating consumption vs degree days = 1,014 m<sup>3</sup> / 2,840 HDD = 0.3570 m<sup>3</sup>/HDD

Heating consumption at 53 HDD/day = (53 HDD/day)(0.3570 m<sup>3</sup>/HDD) = 18.9 m<sup>3</sup>/day

Where gas has an energy content of 37.5 MJ/m<sup>3</sup>, and the furnace has an efficiency of 72 per cent, then:

Heat loss at 53 HDD/day = (18.9 m<sup>3</sup>/day)(37.5 MJ/m<sup>3</sup>)(0.72) = 510 MJ/day or 21.3 MJ/h

As 3.6 MJ/h = 1 kW, then 21.3 MJ/h = 5.9 kW

This heat loss would require a furnace that produces an output of 5.9 kW or 20,100 Btu/h

If we allow the CAN/CSA F280 permissible oversizing of 40 per cent, then the proper furnace sizing would be (1.4)(20,100 Btu/h) = 28,100 Btu/h

If you are calculating for an oil furnace, heating oil has an energy content of 38.2 MJ/litre.

## Calculating fuel cost

Here is a rough comparison of the relative costs of heating an older house in Ottawa. You can put in your own fuel prices and the efficiencies of the appliance that you are choosing to compare relative costs.

The equation is:

$$\frac{\text{Energy cost per unit}}{\text{Energy content}} \times \frac{\text{Heat load}}{\text{Efficiency}} \times 100,000 = \text{cost to heat}$$

Example: For a 92 per cent efficient gas furnace:

$$\frac{\$0.42/\text{m}^3}{37.5 \text{ MJ}/\text{m}^3} \times \frac{80 \text{ GJ}}{92} \times 100,000 = \$974$$

Notes: It is often difficult to isolate the charge per unit of fuel, be it gas or electricity. Include all the costs that relate to the m<sup>3</sup> of consumption for gas (for example, gas supply charge, gas delivery charges, gas surcharges). Electric utilities often also have a bewildering range of charges. Apply all the charges except fixed charges (for example, \$10/month connection charge).

For oil appliances, use 38.2 MJ/litre of oil. For electricity, use 3.6 MJ/kWh and 100 per cent efficiency.

Note: 80 GJ (or 80 gigajoules) is the energy required for heating the example house over the winter. Your own house will likely be different. However, the relative costs calculated for alternative fuels and furnaces in the example house should help you make a selection for your house. For a calculation which includes a wood furnace, consult the CMHC publication *A Guide to Residential Wood Heating*.

## Other useful information products from Canada Mortgage and Housing Corporation

*Home Care: A guide to Repair and Maintenance*  
\$6.95 (order # 61019)

*Homeowner's Inspection Checklist*  
\$19.95 (order # 62114)

*Homeowner's Manual*  
\$22.95 (order # 61841)

*About Your House: Your Furnace Filter*  
Free (order # 62041)

To find more *About Your House* fact sheets plus a wide variety of information products, visit our Web site at **[www.cmhc.ca](http://www.cmhc.ca)**

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