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COMPARISON OF THE COST AND CONVENIENCE OF HOUSE HEATING WITH VARIOUS FUELS

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INTRODUCTION

During the past decade the standard of living in Canada has been materially raised, and this is particularly noticeable in the homes throughout the Dominion. The higher standard has led to the use of many labour-saving devices, such as vacuum cleaners, electric washing-machines, electric or gas stoves, and, particularly, improved house-heating equipment, e.g. the gas or oil fired furnace, which is one of the principal labour-saving devices introduced into the modern home. Electric heaters might also be mentioned here, but this method of house heating is impracticable from economic considerations in any but the most unusual circumstances, where the climate is such that house heating is required for only a few days in the year, or where electric energy, if generated, would otherwise be going to waste. These conditions are seldom found in Canada and, therefore, house heating by electricity will not be considered in this pamphlet.

COMFORT AND CONVENIENCE

Anthracite coal and coke are the fuels most commonly used by the householder in the cities of Ontario and Quebec, whereas fuel oil and city gas are used by comparatively few. The last two fuels, however, are increasing rapidly in popularity, particularly fuel oil. Of these fuels, city gas ranks first as regards comfort and convenience when burned in a furnace for house heating. The gas furnace is silent, clean, easily controlled, and for it a ready supply of fuel is always available. Besides these features there are a number of others which make city gas desirable as a fuel for house heating, as for example the absolute independence of all outside agencies, the elimination of the necessity for storage space in the cellar, and the advantage of being able to pay for the winter's gas supply as it is used, month by month, rather than all at one time, as is the custom of householders using coal or coke. To obtain the advantageous features mentioned, it is necessary to install not only the very best equipment in the way of a furnace especially designed to burn gas, but also thermostats and safety devices.

Good equipment is expensive, particularly the furnace, as compared with a furnace for burning anthracite coal or coke, and this constitutes one of the disadvantages of the use of city gas as a fuel for house heating. The principal disadvantage is the high cost of the fuel itself. This will be discussed in a later paragraph.

Fuel oil, though not quite the equal of city gas for comfort and convenience, is a very close second to it, since it possesses nearly all the advantages, and few disadvantages. When used in conjunction with a good furnace fuel oil is capable of producing a high degree of comfort in house heating; it is easily controlled, fairly quiet, and, in most installations, clean. The disadvantages attendant upon this fuel are due to the fact that nearly all burners require a blower to spray the oil into the furnace and supply sufficient air to ensure perfect combustion. The blower depends as a rule upon electric power for its operation, and although it is described as being fairly quiet, yet there is, whenever the blower motor is in action, a constant hum which is more noticeable because its action is intermittent. With some types of equipment there is not only the hum of the motor but also a roaring sound from the flame, which may be most objectionable at times. A further disadvantage is the slight odour from the oil, which is more noticeable when the oil storage tanks are in the cellar than when they are under ground outside the house, but is always present to some extent. Fuel oil burners require a certain amount of constant attention, except, perhaps, the more expensive ones, and even they are subject to failure as is any piece of complicated automatic machinery. The better class of burners are, as a rule, adequately safeguarded against the risk of the oil catching fire outside the furnace; this cannot be said for all of them, particularly those under manual control. City gas and fuel oil have a great advantage over solid fuels, viz: that they leave no ash nor clinker, the removal of which is a dusty job at the best of times. If the oil and air are not properly adjusted at the burner, smoke may escape into the house and everything it touches will be covered with a film of oily smut.

Coke behaves in a furnace in a manner almost identical with anthracite coal, and for this reason is considered a most satisfactory fuel. Anthracite coal and coke are easily handled and controlled, although they do not adapt themselves so readily to automatic control as do city gas and fuel oil. The hard coal or coke furnace is less expensive to install and entails over a long term of

years little or no expense for upkeep and repairs. The principal advantages of these two solid fuels over gas and liquid fuels are that their cost is lower and that a winter's supply of fuel can be stored, thus rendering the householder independent of outside agencies. Once a fire is kindled—provided the furnace is of proper capacity—sufficient fuel can be charged at a time to supply a steady heat output for from 8 to 12 hours, depending on weather conditions.

Anthracite coal is a most excellent fuel; this is proved by the fact that it has been the staple fuel for house heating in the cities and towns of Central Canada for the last thirty or forty years. The average householder living in the urban centres of Ontario and Quebec, who knew of no other fuel until a few years ago, has in all probability a furnace designed for burning anthracite and has little difficulty in obtaining a high efficiency when using this fuel.

Two very serious disadvantages common to anthracite coal or coke, when compared with city gas and fuel oil, are the production of ash and the necessary daily attendance to the furnace. In mild weather the furnace must be shaken and the ash removed at least once a day, and in severe weather twice a day. This operation is always accompanied by the production of dust and dirt, a certain amount of which will sift through the floors and into the house.

Notwithstanding these disadvantages, anthracite coal and coke give general satisfaction and are economical, especially so when the householder attends to his own furnace and does not reckon the cost of his labour and time, i.e. when only the cost of the fuel is taken into consideration.

COMPARISON OF COSTS

The first question a householder is likely to ask before contemplating making a change in fuel is, what will it cost? This can be answered only in a very general way after making certain assumptions, viz: as regards efficiencies; cost of fuel; type of equipment; calorific value of fuels; and a general assumption regarding the size of the supposed heating load.

The following table gives the relative costs of various fuels and electricity when used for house heating. The comparison has been made, under assumed conditions, on a seasonal heating

load of 162,500,000 B.T.U., which is the heat liberated by 10 tons of American anthracite burned at an efficiency of 65 per cent. The two conditions shown in the table are: first, when the fuels are burned in a furnace designed for use with anthracite or coke; second, when they are burned in a furnace designed for each particular fuel. The other assumptions are:—

American Anthracite Coal. Size, egg or stove; cost, $15.50 per ton (the prevailing price in Ottawa during the winter 1928-29); calorific value, 12,500 B.T.U. per pound average value; efficiency of utilization, 65 per cent. (This figure is lower than the one obtained when this fuel was tested at the Fuel Testing Station, Ottawa, but is selected as being the true average for good furnace operation.)

By-product Coke. Size, egg or stove; cost, $14 per ton (see note on American anthracite); calorific value, 13,000 B.T.U. per pound average value; efficiency of utilization, 65 per cent (see note on American anthracite).

City Gas. Cost, 80 cents per M cubic feet (the price of gas supplied by the Ottawa Gas Company for house heating in 1928-29); calorific value, 500 B.T.U. per cubic foot (the average value of gas supplied by the Ottawa Gas Company); efficiency of utilization (*a*) 70 per cent, this figure is used when computing the cost when gas is burned in an anthracite or coke furnace; (*b*) 85 per cent, this figure is used when the gas is burned in a furnace designed for gas as the fuel.

Fuel Oil. Specific gravity, 0·875 (an average for the fuel oil sold in Ottawa for domestic oil burners); cost, 11·3 cents per Imperial gallon (the prevailing price in Ottawa during the winter 1928-29); calorific value, 19,000 B.T.U. per pound average value; efficiency of utilization (*a*) 60 per cent, this figure is used when computing the cost when oil is burned in an anthracite or coke furnace; (*b*) 70 per cent, this figure is used when the oil is burned in a furnace designed for oil as a fuel. However, as the latter type of furnace is almost unknown in Ontario and Quebec, therefore the figure (*a*) should be the only one used in making a comparison. That this figure is a just one in respect to oil is clearly shown by the following quotation:[1]

"It is doubtful if the average annual heating efficiency of a

[1]Fansler, P. E.: "House Heating with Oil Fuel," 3rd. Ed., p. 221 (1927).

TABLE I

Comparative costs for the same heating load when using American anthracite, coke, city gas, fuel oil, and electricity, in a hot-water heating system

Name of fuel and other particulars	Heater designed for American anthracite				Heater designed for particular fuel under consideration			
	Assumed efficiency of the heater	Quantity of fuel required for the seasonal load of 162,500,000 B.T.U.	Total cost of fuel for the heating season	Relative cost in comparison with American anthracite	Assumed efficiency of the heater	Quantity of fuel required for the seasonal load of 162,500,000 B.T.U.	Total cost of fuel for the heating season	Relative cost in comparison with American anthracite
	%		$		%		$	
American anthracite— Size—Egg or stove Price—$15 50 per short ton Calorific val.—12,500 B.T.U. per lb.	65	10 tons	155.00	100	65	10 tons	155.00	100
Coke— Size—Egg or stove Price—$14 00 per short ton Calorific val.—13,000 B.T.U. per lb.	65	9·62 tons	134.68	87	65	9·62 tons	134.68	87
City gas— Price—80c. per M. cu. ft. Calorific val.—500 B.T.U. per cu. ft.	70	464,286 cu. ft.	371.43	240	85	382,353 cu. ft.	305.88	197
Fuel oil— Specific gravity—0·875 Price—11·3 c. per Imp. gal.	60	1,629 Imp. gal	184.08	119	70	1,396 Imp. gal.	157.75	102
Electricity— Price—1c. per kw. hr. Calorific value—3,415 B.T.U. per kw. hr.	.....	.....	.....	.....	100	47,598 kw. hr.	475.98	307

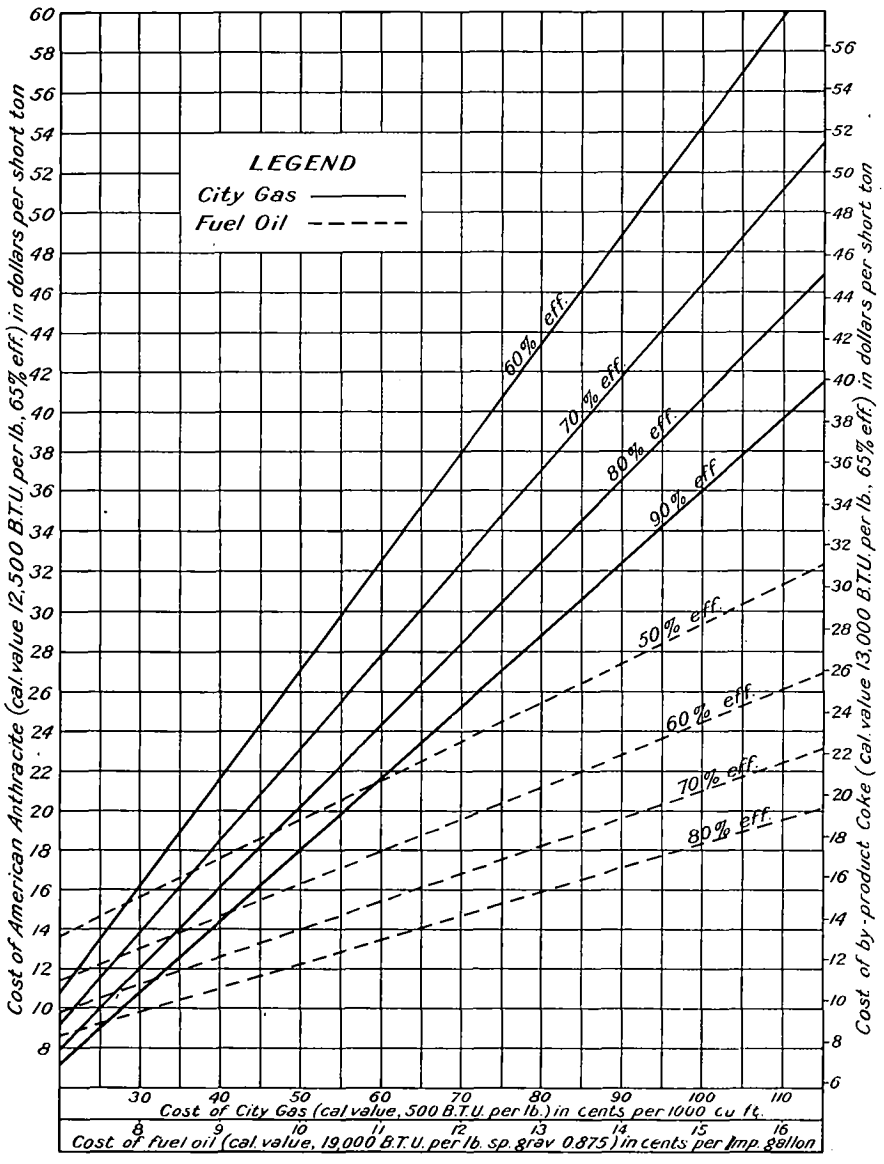
high-class installation, burning oil, may be safely taken at over 70 per cent, and from 50 per cent to 60 per cent might cover the range except in unusual cases."

Electricity has been included in the above table merely to show that, even where electric energy is available for house heating, the cost would be very great.

The table shows that the four fuels when compared as to economic values, are graded in the following order, coke, anthracite coal, fuel oil, and city gas.

The cost of burning fuel oil, at 11·3 cents per gallon, in an ordinary furnace is only 19 per cent higher than the cost of American anthracite. Although at present there is no indication of any increase in this price, it is impossible to say how long this condition will last, but it should be borne in mind that if the price of fuel oil increases only one cent per gallon, the fuel bill will be increased by approximately 10 per cent. The cost of using fuel oil in a furnace specially designed for its use is only 2·0 per cent higher than for anthracite coal, but as such furnaces are only now being placed on the market, the householder will have difficulty in availing himself of the advantages shown by this latter comparison. The cost of house heating by city gas is seen to be high when compared with coal, coke, and oil; and gas for this purpose must be considered generally too expensive for the ordinary householder. On the other hand, there is a tendency towards lower gas prices, and when gas furnaces become more common a considerable reduction may be expected. That coke is an economical fuel for the householder is clearly shown by the table, which gives the relative cost of house heating with coke as 87, as compared with 100, the relative cost when heating with American anthracite—a saving, at present prices, of $20.32 on 10 tons of American anthracite, stove or egg size.

The diagram shown here compares graphically the cost of house heating by means of city gas and fuel oil with American anthracite coal and coke for the same conditions, and assuming the same conditions as shown in the table.


LEGEND
City Gas
Fuel Oil
60% eff.
70% eff.
80% eff.
90% eff.
50% eff.
60% eff.
70% eff.
80% eff.
Cost of American Anthracite (cal. value 12,500 B.T.U. per lb., 65% eff.) in dollars per short ton
Cost of by-product Coke (cal. value 13,000 B.T.U. per lb., 65% eff.) in dollars per short ton
Cost of City Gas (cal. value, 500 B.T.U. per lb.) in cents per 1000 cu. ft.
Cost of fuel oil (cal. value, 19,000 B.T.U. per lb. sp. grav. 0.875) in cents per Imp. gallon

GENERAL TREND OF PROGRESS IN HOUSE HEATING

The rise in cost of anthracite coal during and after the Great War forced the householder to adopt more economical methods of house heating, or to burn cheaper fuels. This is still the trend of the average householder, but for the more well-to-do the trend is towards labour-saving devices. The former has achieved his object by utilizing the cheaper sizes of anthracite coal, viz: pea, buckwheat, and birdseye, and other cheaper fuels such as coke and bituminous coal. It was found, however, that the smaller sizes of anthracite could not be burned in the ordinary furnace without a great deal of care and patience on the part of the furnace attendant—lack of draught through the fuel bed was the main difficulty. However, two methods have been introduced to overcome this difficulty, first, by reducing the thickness of the fuel bed, and second, by using forced draught. The first method was made possible by the invention of the magazine type furnace which is equipped with a sloping grate. This furnace accomplishes two economies: one by burning the cheaper sizes of coal; and the other by saving labour, as the magazine need be filled with fuel only once every 24 hours in severe weather and less often in milder weather. The second method is the cheaper to install, the only additional equipment required being a fan or blower, which is attached to the ash-pit, and a thermostat to cut the fan in or out according to the heat required.

Some mechanical stokers for domestic furnaces are on the market, but they are not great labour savers, as fuel has to be shovelled into a hopper and the ashes removed from the ash-pit as in an ordinary furnace. However, bituminous coal, which is, as a rule, cheaper than anthracite or coke, may be burned almost smokelessly in them, and such stokers lend themselves to thermostatic control, being all operated by an electric motor which can be easily cut in and out to regulate the temperature of the house.

The trend of progress to-day in house heating is towards lower costs for the average householder, and towards the utilization of more labour-saving devices for the well-to-do; but also for both classes there is a marked tendency towards the maintenance of a constant temperature in the house which is secured by the installation, wherever possible, of thermostatic controls.