TECH TIP # 32

HEATING, AIRCONDITIONING & REFRIGERATION DISTRIBUTORS INTERNATIONAL

Comparing Fuel on the Basis of Cost

Since wood is typically sold by the cord, coal by the ton, oil by the gallon and gas by the therm, it is impossible to compare energy costs through direct use of commercial price quotations. Pricing also considers energy sold rather than energy utilized; hence, the overall operating efficiency is not reflected in the sale price.

It is possible to reduce all prices to a common basis and take into account the probable overall seasonal utilization efficiency so that energy costs of the various fuels can be compared.

The therm is the most convenient unit of heat measurement to use as the common basis. A therm is simply 100,000 Btu's. While there is no universal agreement on seasonal utilization efficiency for different types of fuel-fired furnaces or boilers based on research and field measurements, some common values have come into use with a minimum of criticism. In the case of gas and oil fired units, listed Annual Fuel Utilization Efficiencies (AFUE) based on Department of Energy test procedures could be selected. Thus, it is possible to mathematically resolve all energy prices to a dollar and cents per therm of utilized heat.

What follows is a procedure; the prices and efficiencies used in the examples may not apply in every situation or locality, but the method is simple and potentially useful in making a choice in energy alternatives for an ordinary residence.

The basic formula is:

$$\text{Cost per therm of heat utilized} = \frac{\text{Price in cents per sale unit}}{\dfrac{\text{Heating value per sale Unit in Btu}}{100{,}000} \times \dfrac{\text{Assumed efficiency in percent}}{100}}$$

This reduces to:

Cost per therm of heat utilized

$$\text{Cost per therm of heat utilized} = \frac{\text{Price in cents per sale unit} \times 10{,}000{,}000}{\text{Heating value per sale in Btu} \times \text{Assumed efficiency in percent}}$$

Table 1 lists six different energy sources, the most commonly used sale unit, typical heating value, local costs, assumed seasonal efficiency of utilization and finally, the cost per therm of utilized heat.

The table was developed using the formula on page one.

Natural gas:

$$\text{Cost per therm of utilized heat} = \frac{140¢ \times 10{,}000{,}000}{100{,}000 \times 78} = \$1.79/\text{therm}$$

(Note: Natural gas is often sold in terms of CCF, 100 cu. ft. which is usually equal to one therm.)

TABLE 1

Fuel	Sale unit	Assumed heating value as commonly stated	Assumed price per sale unit	Assumed overall efficiency (percent)	Cost per therm of utilized heat
Natural gas	Therm	100,000 Btu/therm	$1.40/therm	78%	$1.79
Oil	Gallon	140,000 Btu/gal	$2.29/gal	78%	$2.09
Propane	Gallon	92,000 Btu/gal	$2.00/gal	78%	$2.78
Electricity	Kwh	3,413 Btu/Kwh	8.24¢/Kwh	100%	$2.41
Coal	Ton	27,000,000 Btu/ton	$182/ton	65%	$1.04
Wood	Cord	22,000,000 Btu/cord	$90/cord	50%	81.8¢

For oil:

$$\text{Cost per therm of utilized heat} = \frac{229 \times 10{,}000{,}000}{140{,}000 \times 78} = \$2.09/\text{therm}$$

For Propane:

$$\text{Cost per therm of utilized heat} = \frac{200 \times 10{,}000{,}000}{92{,}000 \times 78} = \$2.78/\text{therm}$$

For electricity:

$$\text{Cost per therm of utilized heat} = \frac{8.24 \times 10{,}000{,}000}{3{,}413 \times 100} = \$2.41/\text{therm}$$

For coal:

$$\text{Cost per therm of utilized heat} = \frac{18{,}200 \times 10{,}000{,}000}{27{,}000{,}000 \times 65} = \$1.04/\text{therm}$$

For wood:

$$\text{Cost per therm of utilized heat} = \frac{9{,}000 \times 10{,}000{,}000}{22{,}000 \times 50} = 81.8¢/\text{therm}$$

It is also possible to rearrange the relationship so that knowing the cost of one fuel --- say natural gas; it is possible to determine at what price any other fuel must sell to be competitive.

$$\text{Comparable Selling price} = \frac{\text{cost/therm of natural gas} \times \text{heat value per sale unit} \times \text{efficiency}}{10{,}000{,}000}$$

For example, for wood to be competitive with natural gas selling at 97.2¢/therm of utilized heat, then wood must sell at:

$$\text{Selling price} = \frac{97.2 \times 22{,}000{,}000 \times 50}{10{,}000{,}000} = \$106.92/\text{cord}$$

This procedure can, of course, be repeated for the other fuels.

It must be emphasized that cost is not the sole criteria for selecting a fuel. Coal, for example, is not permitted by code in many municipalities. Potential price increases, cost of equipment, structural changes to accommodate equipment, availability, interruptability, maintenance, life expectancy, convenience and comfort performance must also be considered.