Combustion comparison

To generate electricity you need a certain amount of heat to boil water and drive a steam turbine. But you can get that heat from many different sources, including coal, natural gas, nuclear power. The choice depends on cost and effect on the environment.

Most of the fuels currently in use are fossil fuel **hydrocarbons** : molecules containing a mixture of carbon and hydrogen. Burning these in air (which contains oxygen) produces mostly water vapor (H_2O) and carbon-dioxide (CO_2) which is a "green house gas" (GHG). If we care about reducing CO_2 emissions, it seems like the fuel that generates the most energy with the least CO_2 would be the best. Calculate that for a couple of different hydrocarbons:

In this assignment

- You'll calculate how much CO_2 (in grams) is emitted when you *burn* (combust) enough of each type of fossil fuel to give off 1 Calorie (=1 kilocalorie) of heat (thermal) energy.
- You'll also look up the cost of different fuels for the same amount of heat generated.

Gasoline (av. octane) - C_8H_{18} - combustion: 10.8 Calories / gram

$$2\,C_8H_{18} + 25\,O_2 \rightarrow 16\,CO_2 + 18\,H_2O \quad (1)$$

Atomic weight of...

- 2 octane molecules = ??
- 16 carbon dioxide molecules =

So, _____ g of CO_2 are produced for every _____ g of gasoline

We want grams of CO_2 / Calorie:

$$\frac{[\quad\quad]\ \text{g}\ CO_2}{[\quad\quad]\ \text{g}\ gasoline} * \frac{1\ \text{g}\ gasoline}{10.8\text{Cal}} = [\quad\quad]\text{grams of}\ CO_2/\ 1\ \text{Calorie.} \quad (2)$$

Natural gas (methane) - CH_4 - combustion: 13.3 Calories / gram

$$CH_4 + 2\,O_2 \rightarrow CO_2 + 2\,H_2O \quad (4)$$

Atomic weight of...

- 1 methane = ? =
- 1 carbon dioxide = ?

So, _____ g of CO_2 are produced for every _____g of methane :

We want grams of CO_2 / Calorie:

Coal - C - combustion: 6.5 Calories / gram

$$C + O_2 \rightarrow CO_2 \quad (6)$$

Atomic weight of...

- 1 Coal = 1 C =
- 1 Carbon dioxide =

We want grams of CO_2 / Calorie:

So now we can compare CO_2 emissions for the same heat (in Calories) for different fuels:

Fuel	CO_2 emissions (g/cal)
hydrogen	0.0
natural gas (methane)	
gasoline (~octane)	
coal (~ pure carbon)	

Cost comparison

This page **http://tinyurl.com/costofE** (from a government agency) contains a table which compares the costs of coal, oil, and natural gas in US$ per million BTU. Make sure you can do the calculation of cost/energy from the numbers they provide and get the same answer.

	Price	Btu (Energy Content)	$/Million Btu
Coal	$44.64 per ton	21 million per short ton	$2.13
Oil	$56.35 per barrel	6 million per barrel	$9.39
Natural Gas	$5.27 per Tcf	1 million per Tcf	$5.27

The number of BTUs for each fuel type doesn't change, but the costs they cite may be out of date. Scour the Internet to find recent costs of oil, coal, and natural gas. For each price, cite the website you used, find out and write a sentence or two about the organization behind the website, and write a sentence or two on why you think it's trustworthy.

Then recalculate the table using the current costs you found for each fuel, to get a figure in $ / Million BTUs based on the costs you uncovered. You may need to do further conversions, e.g. on WolframAlpha. Show each calculation with units.