## Assignment 1: ENVS/ENGR 119 Energy and the Environment (Prof. Ben)

You must show all of your work for full credit. The MIT Conversion Sheet is the best resource for working on unit conversions and energy transformations (Do not Google the conversion as you may end-up with different rounding). Please write your calculation by hand or type it if you know how to deal with equations on your Word processing software and return this assignment sheet completed in .PDF format. All numbers must be labelled with proper units, rounded to the closest digit (no decimal), use a coma to separate the thousands.

Example: Convert 100 kWh into joules.

$$
100 k W h x \frac{3.6 M J}{1 k W h}(A) x \frac{1,000,000 J}{1 M J}(\mathbb{B})=360,000,000 \mathrm{~J}
$$

(A) See MIT Units \& Conversions Fact Sheet, Energy Unit Conversion $1 \mathrm{kWh}=3.6 \mathrm{MJ}$
(B) See MIT Units \& Conversions Fact Sheet, Prefixes / Metric mega $(M)=10^{6}=1,000,000$

Part 1: Unit conversions: Calculate the total energy used by an average household in standard Kilo British Thermal Unit, including the different types of energy used.

1. Convert 560 kWh (average CA home electricity use per month) into kBtu. Calculate the annual total (assuming each month the same amount of electricity is used).
2. Convert 2 therms (average CA home natural gas use per day) into kBtu. Calculate the annual total (assuming each day the same amount of electricity is used). note: 1 therm of natural gas at standard temperature and pressure $(S T P)=96.7 \mathrm{ft}^{3}$
3. On average, a typical CA household will use 5 gallons of gasoline per day. Calculate the annual total in kBtu (assuming each day the same amount of gasoline is used).
note: 1 mBtu (roman) $=1 \mathrm{kBtu}$ (metric)
4. Calculate the total average CA household energy use in kBtu per year, the percentage each type of energy represents of the total.
a) Total/year
b) Percent of electricity
c) Percent of natural gas
d) Percent of gasoline

## Part 2: Energy budget

5. Given average electricity price is $\$ .19$ per kWh, average natural gas is $\$ 1.40$ per therms and average premium gasoline price is $\$ 3.50$ per gallon. Calculate the annual budget in dollar for each of the three type of energy use by an average household.
6. Calculate the total average CA household annual budget per year, the percentage each type of energy represents of the total.
a) Total/year
b) Percent of electricity
c) Percent of natural gas
d) Percent of gasoline

Essay question A: Which source of energy is the cheapest per unit (kbtu)? In other words, if we want to reduce the cost of living which type of energy should we chose by default to run everything in our households?
7. The emissions factor of PG\&E electricity 0.5 lbs . of CO 2 per kWh , Calculate the total carbon footprint (electricity, natural gas, and gasoline) for an average household (see Carbon Dioxide Emissions Factors from MIT data sheet for natural gas and gasoline).
8. Calculate the total average CA household carbon dioxide footprint in lbs per year of CO 2 , the percentage each type of energy represents of the total.
e) Total/year
f) Percent of electricity
g) Percent of natural gas
h) Percent of gasoline

Essay question B: Which source of energy is the most climate friendly? (think about less emissions per unit of energy kBtu) In other words, if we want to reduce the pressure on Climate change which type of energy should we chose by default to run everything in our households?

