

Problem Set 2

Intro to Sustainable Energy 2.650/10.291/22.081

&

Sustainable Energy 1.818/2.65/10.391/11.371/22.811/ESD.166

For each of the problems you work out provide a list of sources for any data you used, as well as your assumptions. Be sure to mark which course number you are registered for on your solution. You can turn in the homework online (via Stellar) or in class.

Intro to SE Students: Pick any 2 of the 4 problems to solve.

SE Students: Pick 3 of the 4 problems to solve.

1. *Energy conversion:* The combustion of octane takes multiple steps, but these can be condensed as
$$2\text{C}_8\text{H}_{18} + 25\text{O}_2 \rightarrow 16\text{CO}_2 + 18\text{H}_2\text{O}$$
 - a. If this process is 100% efficient, how much thermal energy is produced via the combustion of 1 gallon of gasoline? Use the provided enthalpies at the end to support your answer.
 - b. Gasoline consists of octane plus a number of other hydrocarbons. How much thermal energy is produced via combustion of a gallon of gasoline? What component of this comes from combustion of octane?
 - c. Select a passenger car and calculate the efficiency of the vehicle in converting chemical energy from combustion into kinetic energy.
2. *Efficiency:* You haven't been to the grocery store in a while, and all you can find in your apartment is a few packets of ramen noodles.
 - a. Calculate how much energy would be needed to raise the two cups of water you need to cook your ramen to its boiling point.
 - b. List the sources of inefficiency associated with boiling this water in an electric kettle, and find values for or estimate efficiency values for each energy conversion. Trace back as far as your assumed electricity source.
 - c. How does the situation change if you heat the water on a gas stove? What inefficiencies are avoided, and what are introduced? Estimate (rough estimates are fine, but state your assumptions clearly) the total amount of gas needed to cook your meal.
3. *Personal Energy Audit*
 - a. Recently, *Sierra* magazine (Jan-Feb 2003 issue) published a short Ecological Footprint Quiz that was designed by The Redefining Progress Group, based in Oakland California, to help people determine their "ecological footprint" – or how much land is needed to support their individual lifestyle. Please use their format to estimate your personal ecological footprint in acres of land. Go to: <http://www.earthday.org/> to take the quiz. Print your quiz results page and submit with your homework.
 - b. Alternatively, the Carbon Fund Foundation has developed a "carbon footprint" quiz. Go to: <http://www.carbonfund.org/site/pages/calculator> to estimate your carbon footprint. Print out your quiz results page and submit with your homework.

- c. Compare the merits and shortcomings of both of the quizzes. What, if anything, would you add, subtract, emphasize, or de-emphasize?
4. *Climate Change*: Read a recent news story on the estimation of the carbon inventory of rainforest: <http://www.newscientist.com/article/dn19408-forest-carbon-stores-may-be-massively-overestimated.html>. Take the role of an advisor to the UN's Reducing Emissions from Deforestation and Forest Degradation in Developing Countries initiative. In light of the facts mentioned in the article, what actions would you recommend? Summarize your recommendations in a page. Cite any supplementary sources you use.

Enthalpies of fusion for Problem 1

C ₈ H ₁₈	-249.9 kJ/mol
O ₂	0 kJ/mol
CO ₂	-393.51 kJ/mol
H ₂ O	-241.82 kJ/mol

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