What difference would it make in the United States if everyone…

Switched all residential light bulbs to compact fluorescent bulbs?

Everyone stopped eating beef?

Stopped taking short-haul airline flights and drove in high-efficiency hybrids instead?

Switched all major home appliances to Energy Star appliances?

Switched all interstate freight transport from trucks to freight trains?

Properly inflated the tires on their vehicles?

An important skill in environmental studies is being able to prioritize among environmental problems and strategies. What issues are most pressing? Which solutions are most effective? This assignment focuses on the latter question, although the same skills can be used to identify problems too.

At the individual level, we've been bombarded with ways to reduce our carbon footprints recently: should we stop using disposable water bottles, switch to compact-fluorescent bulbs, buy a hybrid, or take one less round-trip cross-country airplane flight each year? As a society, we face broader policy choices about energy generation technology, automotive technology, and land management policy.

It would be good to do everything possible. But, in reality, we have only so much time and some many resources. So, if we can only do some things, which of those actions would make the most difference? To figure that out, we need to be able to do some back-of-the-envelope calculations based on available information and reasonable estimates.

Your assignment: Make a reasonable estimate of what difference it would make if the United States (or all citizens in the U.S.) did x. Your write-up should include three steps (as modeled on page #3 of the assignment). You should **first** present your final estimate, **second**, succinctly present your calculations, and, **third,** provide a useful explanation of your sources, assumptions, and (perhaps most important) reservations you have about and limitations to your approach. Your final answer should be in metric tons of CO_2 saved during one year as a result of x **and** what fraction that is of the total U.S. emissions (5891 million metric tons CO_2 in 2005 according to CAIT).

Sources: Many of the sources you'll rely on for this assignment will come from the web. You need to exercise your good judgment, using the best available sources (and not using sources that might be unreliable). Include your sources in step #3.

Assistance: Let me know if you get stuck. I'm happy to help.

A few tips…

1. Do your results seem reasonable? This is the most important question to ask in a back-of-the-envelope calculation! It is why I ask you to compare your estimate to U.S. annual emissions. If your number is vanishingly small or surprisingly large, then is a warning that your estimate may not be reasonable (in which case you want to double-check your calculations, method, and ask me for help if you need it).

2. If you are doing calculations comparing different modes of transportation, do not forget to take into consideration that planes, trains, trucks, and cars all have very different capacities. Be sure to factor that into your calculations!

3. Are your sources reasonable and reliable? To complete this assignment, you'll spend a lot of time on the web ferreting out useful sources of information. The best sources tend to come from the federal agencies that oversee various programs related to transportation, energy efficiency standards, and agriculture. Other good sources are studies conducted by reputable environmental groups, consultants, and scholars. Here are some sources to watch out for: another college class's web-page on a similar topic; a single reference in a newspaper article; an advertisement. These sources do have their uses…they can give you leads where you can find better information. If you aren't sure about a source or you can't find information you need, let me know!

4. Did you check your assignment for arithmetic and unit errors? (Please do!)

5. Are you using the correct units? Ask me if you aren't sure.

6. Are you presented your calculations in a logical fashion that someone else could understand?

7. Are you being consistent in how you use significant digits? For this assignment, we are doing estimates, so 2 or 3 significant digits is sufficient.

Have fun! Be creative! Let me know if you want to brainstorm!

Estimate: Properly inflating all non-commercial vehicle tires would result in a reduction of 6E6 metric tons of C, which is .41% of U.S. annual emissions (1461 million metric tons C).

Step 1. Back-of-the-envelope calculation

Use this format as a template, marking lines with A, B, C and using those annotations to explain calculations and sources.

What is the efficiency gain in mpg for properly inflating tires?
A. Inflating tires properly is estimated to raise fuel efficiency by 3%.
B. The average fuel efficiency of a U.S. car is 24.5 mpg.
C. 3% increase in fuel efficiency is 25.235 mpg (AxB)

What is the savings in gasoline per car per year for properly inflating tires?
D. The average cars travels 12,500 miles per year.
E. Each car uses 510 gallons (D/B) or 495 gallons (D/C) of gas if tires are inflated
F. Properly inflating the tires saves 15 gallons of gas per car per year (E1-E2).

What is the total savings in gasoline for if all cars properly inflate tires?
G. There are 200 million cars in use.
H. 8 out of 10 cars have under-inflated tires.
I. Total savings in gasoline for all cars by properly inflating tires 2400 million gallons of gas. (GxHxF)

National savings in C for inflating tires
J. Each gallon of gasoline burned produces 20 lbs of CO2 (E) or 5.5 lbs of C.
K. Total savings for inflating tires of all cars is 132E10 lbs C or 6E6 metric tons.

Step 2. Evaluation of assumptions and data sources

A. Source: U.S. Department of Energy, "Tips for keeping your car in shape." http://www.fueleconomy.gov/feg/maintain.shtml

B. According to the Corporate Average Fuel Economy Standards, the average car gets 27.5 miles per gallon and the average light truck 20.2 miles per gallon. I estimated that 60% of vehicles are cars and 40% trucks to get a composite fuel efficiency figure. Source: National Highway Traffic Safety Administration, "Summary of fuel economy performance," March 2004. http://www.nhtsa.gov/cars/rules/CAFE/docs/Summary-Fuel-Economy-Pref-2004.pdf

D. Source: U.S. Environmental Protection Agency, "Greenhouse gas emissions from a typical passenger vehicle" February 2005. http://www.epa.gov/otaq/climate/420f05004.pdf

G. Although the data on average vehicle miles traveled per car is readily available, it is unclear how many passenger cars travel this distance in the United States each year. It would be worth looking for total vehicle miles traveled in the United States as an alternative approach to this problem.

H. This is a guess. I have no data on how many cars have under-inflated tires. I'm not sure where to get this data either.

J. Same as D.