Solar, Transportation

Schwartz Problem Set #7

Due Last day of class, Wednesday, June 7

1. I think an electric car (or any other car) has a transportation efficiency of about 7.5 km/kWh, and that this is for a driving speed of 65 mph (please change to km/hr).
   a) Please check this number in the literature.
   b) Please find the rate of power delivered by the engine in Watts and HP.
   c) If a comparable gasoline driven car gets mileage of 30 miles per gallon driving at 65 mph, please find the rate of power *intake* in the form of gas, and estimate the efficiency of this engine at this speed.
   d) Please find the mass of Li-ion batteries necessary to drive this vehicle 100 miles. You may need to look up energy densities or find them from the videos. The videos are now almost a decade old, so things have changed a little.
   e) Given the power densities I have for batteries supplied in the videos, for the above battery packs, what is the maximum power I could draw from the batteries? Is this power enough to kick ass or would I need some other energy storage device like a super capacitor? In order to answer this question, please consider the power output you'd need to accelerate the care of your choice to the speed you want in the time you want to do it. On average, badass cars accelerate at about a gravity up to around 60 mph… ~ 30 m/s.

2. Calculate the surface area of standard PV panels (15% efficiency) necessary for you to live your life. Please include the following consideration:
   a) We live in SLO and can anticipate the corresponding solar incidence.
   b) You continue to use electricity like always, and continue to drive like you always do, but in a (shared?) electric car.

   Please give your answer in square meters…. Does this area seem reasonable to you? Do you feel you are taking too much of the planet's surface area with this?
   c) Indicate what kind of lifestyle changes you would need to make in order to live like this.

3. We have seen how solar deployment has been growing at a near exponential rate. We have also learned about the learning curve: That the cost of a technology decreases with the total deployment of that technology. For instance, look at a car: ~$10,000 for about 100 kW: *10 cents a Watt*… and that $10,000 covers way more than the engine. That's because we humans have considerable experience, having produced… maybe a few billion cars. Anyway, please look up some graphs of how global deployment of solar electricity has increased over the years, and how the cost to produce solar panels has decreased:
   a) If these trends continue through 2025, please project the cost to produce solar and total global deployment in 2025. Please include the graphs or references you used.

b) Of course, this trend will not continue indefinitely. Project when total global consumption of electricity can be met by solar… be careful to include consideration of duty cycle.

4. Please read this article on improving infrastructure (http://www.npr.org/2017/03/09/519500054/engineers-say-tax-increase-needed-to-save-failing-u-s-infrastructure) and consider three questions:

a) $2 trillion... is that a lot? Of course, what this question should mean is to find a way to compare it to something that makes sense. For instance, how much is this per US American? Or better yet, per US American family?
b) $0.25 per gallon gasoline tax? How long would it take to bring in $2 trillion at the rate we use petroleum?
c) Would you consider this a market mechanism? To what degree is this *internalizing* an *external cost*? To what degree is it just raising money and not internalizing an external cost?

5. Consider the different transportation technologies: ICE, BEV, Hybrid, Plug in Hybrid, H_2 Fuel Cell, and maybe something else that you could add. Please identify the pros and cons of each technology.