

Midterm #2.

1. The grid.

- a) Some economists argue that each consumer should be charged the marginal cost of electricity at the time of use plus externalities. Please make an argument supporting or contradicting this statement. You'll be judged not by your judgement, but your expressed understanding the concepts.
- b) As part of AB 32 (Assembly Bill 32, the 2006 Greenhouse Gas Reduction Bill), California is committed to reduce California's GHG emissions to 1990 levels by 2020. Part of the effort is introducing more renewable energy into the electricity grid. Please describe ***the challenges that the grid may experience as we increase renewables into the grid***. I expect to see a drawing the California Load Curve and some numbers if you have them in order to put things in perspective.
- c) Also ***describe some strategies*** to answer the challenges from b) above. *Make sure you include both supply side and demand side strategies.*
- d) Describe the causes of the California Electricity Crisis of 2001 and what has been done to end it, and what are our present challenges?... *I didn't ask this question because we hadn't given it adequate attention. But we will so be ready.*

Although there is always difficulty with corruption and conspiracy of billionaire networks, the answers should be focused on technology and planning issues. I realize that the class walks a fine line on politics in order to address the realities of energy markets, but please focus on technical and policy issues.

Several folks discussed the split in responsibility for costs between the producers and the consumers (decision makers). However, this is a false question. The extra cost would most easily be charged to the direct impact... the generation facility... How would they pay this extra cost? Who would ultimately bear the cost?

Please are mixing up demand from demand minus solar power. Please have a look again at the California load curve on the ISO website.

2. Nuclear Energy **Some of this information was in the videos.. especially the first video on nuclear energy. You might consider watching it again with these questions sharp in your thoughts.**
- a) What is “mass defect” or “mass deficit” and why do we care?
 - b) How does one make a self-sustained nuclear chain reaction? Don’t just tell me a word or sentence. Please fully describe what we need to do and how it works on the microscopic level. **It’s not enough to say, “get a critical mass”, but explain what critical mass means... and what it depends on. Having enough mass is just part of it. How do these variables affect what’s happening between neutron and nucleus? You should know the difference between “control rods” and “moderators”. How are their roles different?**
 - c) How do we control a nuclear chain reaction so a nuclear reactor isn’t just a nuclear bomb? **Few students know the difference between moderator and control rod.**
 - d) What caused the Fukushima disaster in 2011? Don’t just say “a tidal wave”. What happened inside the reactors and why? **Many students don’t understand this disaster, indicating need to better understand the underlying concepts better. I think that it is of considerable importance that students in this class have a technical understanding of these issues. I suggest you at least read through the Wikipedia introduction paragraph:**
https://en.wikipedia.org/wiki/Fukushima_Daiichi_nuclear_disaster
 - e) Maybe you mentioned “delay neutrons” in the above answers. If not, please do that now. What do “delay neutrons” have to do with any of this? **In particular, in controlling reactions and nuclear disasters.**
 - f) What are your thoughts about nuclear safety? Please don’t just give me your concerns or your feelings. Please back up what you have to say with numbers and/or put in the context of costs and benefits of *other heating technologies*

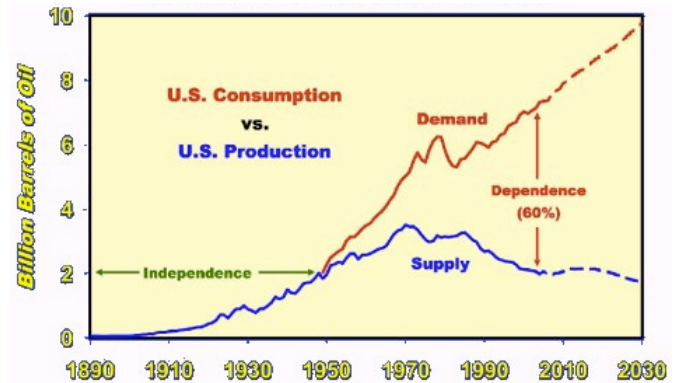
3. You drive to San Francisco and back. I was surprised to see how badly people converted commonly used values... such as what is the mass of a gallon of gas? It didn't cost you a lot, but please have an idea in the future. I also wanted to know about the refining process. I was disappointed because I didn't get too many people explaining it. This is my own fault for not asking more explicitly about it. But below, please do this.
- a) How much gas did you use?
 - b) How many kg of CO₂ did your trip contribute to the environment?
 - c) What is the rate of heat dissipation into the environment *while you were burning the gas during your trip*. Please put your answer in Watts. **Why do we not care about the efficiency? Why does 100% of the energy turn to heat?**
 - d) Where did your gasoline come from? Could you please describe a narrative with possible drawings describing the full process from the *primary source* of energy to the earth's surface until you burn it in your car. *Pay particular attention to the process that yields gasoline from the crude oil.*
 - e) *What portion of the earth's remaining accessible petroleum did your trip use?*
 - f) *By what portion did your trip increase the total anthropogenic GHG?*
 - g) *What is the increase in radiative forcing due to your trip?*
 - h) *Estimate the total rate of global heating due to your increase in GHG.*

4. Climate Change Green House Gas emissions

- a) *Clearly describe the mechanism* that causes anthropogenic climate change.
- b) The climate has always been changing, so why are people concerned about *this* climate change?

5. Please look at the graph at right, likely made around 2006 in US oil consumption and oil production. *The dotted lines are the prediction they made at the time.* I should have explicitly requested consideration of price in explaining the changes you see and foresee.

- a) Please extend the graph to 2016.
- b) Please describe the cause behind the recent trends that you just updated



- c) What do you expect to happen in the coming 10 years? Extend the graph above to 2030 and explain why you think this will happen below.

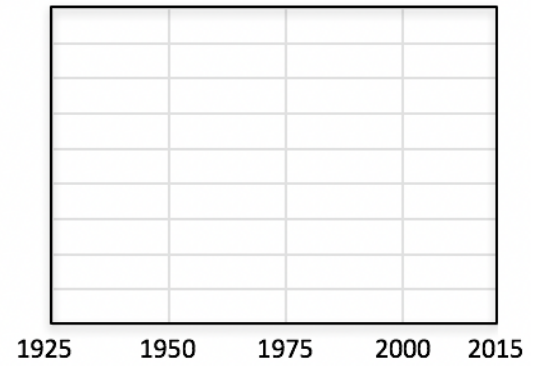
6. Green House Gas emissions **This one wasn't on the exam, but should have been.**

c) What is the present annual USA *per capita* CO₂ emissions? _____

d) On the graph, show total annual *national* emissions of CO₂ for both USA and China. Label the two curves, so I can distinguish them. You don't have to put the scale on the y-axis, we can just focus on understanding the general behavior.

e) Please comment on why the two graphs look different and what this means about each country's development.

f) explain the trend we've seen in the last 5-10 years and why.



What's your name? _____