

- 1) Numbers
  - a) How many people live in California?
  - b) About how much electrical power is consumed in California?
  - c) How much power is generated at Diablo Power plant?
  - d) How much power could you generate for a minute if you worked really hard with your body?
  - e) You notice your computer is pretty warm. About how much power is it drawing?
- 2) I'm horrified when I walk in building 53 in the morning to sometimes find that the lights in a room have been left on all night (14 hours with no one there!). Each lighting tile has (I think) 2 tubes at 40 W per tube, and there are three rows of 6 lighted tiles, meaning 18 lighted tiles, except they're not all working. So, we're talking about 1500 W. Estimate:
  - a) The financial cost to Cal Poly for this mistake
  - b) The CO<sub>2</sub> emitted into the atmosphere because of the mistake
  - c) Your friend tells you that there is almost no CO<sub>2</sub> emitted into the atmosphere because we're getting electricity from Diablo, and nuclear is almost carbon-free. Why would you agree or disagree with this friend?

3) Heat Engines

a) How do all heat engines work? Explain: what are the steps that the air goes through to drive a heat engine?

b) Describe a Brayton cycle (gas turbine). Carefully explain with a good drawing how this works through the steps you describe above – not just a flow chart – please include images so we know how the machine actually works.

c) Please draw an energy flow diagram explaining the energy transitions for the device you chose above. Please extend the energy flow back to primary energy, and forward to the final energy form.

d) What limits the efficiency of a Brayton Cycle? What can we do about it to get better efficiency?

- 4) In international negotiations, countries argue about how much CO<sub>2</sub> they're allowed to emit.
- a) I thought that we wanted to reduce CO<sub>2</sub> emissions. Why would a country want to increase CO<sub>2</sub> emissions?

- b) We learned that China's CO<sub>2</sub> emissions are increasing, but the CO<sub>2</sub> intensity of their economy is decreasing. Please explain how this can happen.

5) Coal vs Natural Gas,

- a) Why does Coal put so much more CO<sub>2</sub> into the environment than NG? (two reasons would be best)

- b) What issues of Environmental Justice arise from coal-fire generation?

6) How does an electric generator work? Explain with a drawing.

7) You are turning an electric generator connected to a bunch of lightbulbs, but they are turned off. As you are generating the electricity, someone turns the lights on.  
a) What do you experience?

b) Why do you experience this?

- 8) California Electricity. How do you see things changing in the next decade?
- a) **Generation:** What changes are coming for how California generates electricity?
  - b) What challenges with these changes bring?
  - c) Describe a “smart grid” mechanism to remedy the above challenge?
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- 9) The economist says, “in order for the market to work, the decision-maker must bear the full cost of their decision.”
- a) Using Coal-fire electricity as an example, please explain how externalities act as strong market distortions to prevent the market from working.
  - b) Describe a market mechanism that might correct this.
  - c) Describe a command and control mechanism that might correct this (can’t pick “outlaw coal”)

- 10) Energy markets: There's an area that periodically has blackouts because the power lines can't provide all the current that is needed for everyone, although at other times, there's grid capacity for more current than is being used.
- a) Describe a supply side solution for this problem
  - b) Describe a demand side solution for this problem.

- 11) Mercury is poisoning our fish!
- a) Where does this mercury come from? Completely describe the origin.
  - b) What do you think we should do about it?
  - c) As the new director of the EPA, please suggest a policy that will remedy this problem and why it will work.