

**ESRP 285. Climate Change, 2nd Exam, April 3, 2008. Answer Sheet**

1. CAFE stands for: (pick one): Corporate Average Fuel Efficiency
2. A CAFE standard was enacted in 1975. It called on new vehicle efficiency to improve by the year 1985. The target was: 27.5 miles/gallon
3. Congress extended the CAFE standard in 2008. The new goal was set to: 35 miles/gallon

Suppose the world has 2,000 million vehicles in the future, and each vehicle travels 10,000 miles/year with a fuel efficiency of 25 miles/gallon. Assume that there are 10 kilograms of CO<sub>2</sub> emissions associated with each gallon of gasoline consumed. Answer the following questions (and show your work):

4. How many billion gallons of gasoline would be consumed per year?: **800**

2,000 million cars \* 10,000 miles/yr per car is 20,000 billion miles/yr. Divide by 25 miles/gallon, and we get 800 billion gallons/yr are consumed.

5. What are CO<sub>2</sub> emissions, measured in billions of kilograms per year **8,000**  
800 billion gallons/yr \* 10 kg/gallon = 8,000 billion kg/yr

6. What are the CO<sub>2</sub> emissions, measured in metric tons per year? **8 billion**  
a metric ton is 1,000 kg, so the answer is 8 billion metric tons/yr

7. What are the CO<sub>2</sub> emissions (in metric tons per year) if we improve the fuel efficiency to 50 miles per gallon? **The emissions are cut in half. The answer is 4 billion MT/yr**

8. The Princeton Wedges study describes different actions to lower CO<sub>2</sub> emissions in the next 50 years. They use the term "wedge" to describe a: reduction in world-wide carbon emissions by one billion metric tons/year

9. During the late 1970s and 1980s, electric utilities in the USA changed their view of the demand for electricity. ... the new view was that growth in demand could be slowed if the company and the customers worked together to improve efficiency of homes and businesses. This change in attitude was especially pronounced in the northwest.

**Explain the reasons for this change in the space below:** The utilities found themselves in financial trouble from trying to build large power plants to keep pace with the rapidly growing demand. They asked their regulators to allow further rate increases, and many of these were granted. But still, they were in financial trouble. They came around to the view that slowing the growth in demand could give them some relief from the financial problems. So they took the initiative of making incentives available to their customers. This turned out to be a good thing for their finances, and it was good for the customers. They got help with improving the efficiency of their homes, and their monthly electric bills were lower as well.

10. Mark the following statements about “cap and trade in carbon” as TRUE or FALSE

FALSE The “cap” in cap and trade refers to a cap on the price of CO<sub>2</sub> emissions.

TRUE The “trade” in cap and trade refers to the buying and selling of allowances.

FALSE The price of allowances in a carbon market is specified by legislation.

TRUE With certain information about future energy prices and technologies, it should be possible to design a carbon tax to achieve the same emissions reduction that would be specified with cap and trade.

11 – 15: You will see where to place the K (Kyoto), W (Wedges), S (S139) from the graph that you have seen many times in class and in the website documents. The goal from Senators Clinton and Obama were discussed in a student presentation. Both Senators have called for a reduction 80% below 1990 emissions. So the C and O would appear next to the lowest target on the graph.

16. Explain the black bars at the bottom of the chart. In particular, explain why the bar for “Less Regular Coal” is so much bigger. The reason is that coal is used extensively in electricity generation (around 50% of the US generation) and that coal is the most carbon intensive of the fossil fuels. When we put a price on carbon, the cost of burning coal will increase more rapidly than other fossil fuels. Investors will not build new plants, and the owners of the older plants will find them increasingly expensive to operate. Eventually they will be too expensive, and they will be phased out of operation.

17. Explain the “Demand Reduction” bar in the diagram. The EIA estimated that the cost of carbon allowances would cause the retail price of electricity to go up. When consumers feel the higher prices, they will react with somewhat lower electricity demand. This bar is EIA’s estimate of the price-induced response. Some students said that demand will be lower due to utility conservation programs. This was a good response as well (even though it was not part of the EIA analysis summarized in the bar chart.)

18. The top three bars in the diagram are shaded differently than the others. Explain what is different about the technologies at the top of the diagram.

The top three technologies require further research and development to be economically competitive and/or to resolve serious questions about their safety.

19. Explain why there is no entry for the “Fuel Cost” for wind. Almost everyone got this right.

There is no fuel cost for wind because the wind is free.

20. Explain the term “shaping cost”: However, only a few students got this right.

Wind is highly irregular, so we don't see generation at locations where the wind is not blowing. The shaping cost refers to the extra cost that the wind farm owner faces to back up the wind generation with another source of generation. The cost might come from buying generation from a hydro facility. The water behind the dam might be drawn down when the wind is not blowing.

21. Explain why there is no entry for the “shaping cost” for CCs.

The delivery of natural gas to a CC power plant is much more reliable than the “delivery of wind” to a wind farm. So we don't talk about “shaping costs” for such power plants. However, these plants do need to go down for repairs from time to time. The system operator is accustomed to these “outages” so an extra shaping cost is not imposed on the owner.

22. Explain why there is no entry for the “Production Tax Credit” for CCs.

The PTC applies to renewable sources of electricity generation (i.e., wind and biomass). CCs burn natural gas which is non-renewable. So they do not qualify for the credit.

23. The prices on the left-side of the graph range from around 20 to 30 €/per ton. An MIT study looked at how these prices compared to what economists expected given the goals of the ETS.

The MIT study concluded that these prices were **shocking high** compared to what most economists would have predicted

24. The graph shows an abrupt decline in the ETS price in May of 2006. This decline occurred:

after the release of the ETS registry report on actual CO<sub>2</sub> emissions

25. Many states in the USA have passed RPS legislation. The letters RPS stand for:

**Renewable Performance Standard**