

ESYS 10: Introduction to Environmental Systems
Winter 2008
Week #9 discussion assignment

The issue of how to guide the global energy policy over the next few decades is obviously one of the most fundamental questions facing mankind. Several years ago, researchers at Princeton University (S. Pacala and R. Socolow) published a paper* that outlined 7 different possible steps required for reducing carbon emissions to levels that would stabilize the carbon cycle. Their suggestions were featured at the end of Al Gore's movie, An Inconvenient Truth.

Let's examine each of the 7 steps in the context of the global system. For each of these 7 possible "solutions", I want you to describe one primary cost (or potential barrier to implementation) and one primary benefit aside from the reduction of greenhouse gas emissions. I also want you to give a simple assessment of whether you are optimistic or pessimistic about overall outlook for these solutions—in other words, whether, for you, the cost/benefit ratio is high or low. Note that each of these possible "solutions" already factor in the anticipated increase in global population (and therefore increased demand for energy), but they assume only currently available technologies.

- 1.) Transportation Efficiency: Build 2 billion passenger cars with a fuel efficiency of 60 miles per gallon of gasoline instead of 30 miles per gallon. There are currently about 600 million passenger cars worldwide.
- 2.) Biofuels: Convert 2 billion cars with a fuel efficiency of 60 miles per gallons from gasoline to biofuels. Biofuel production at this scale would require 2.5 million square kilometers (964,000 square miles) of high-yield crops, about one-sixth of world's total cropland
- 3.) Nuclear power: Build nuclear power plants with a total electricity-generating capacity of 700 gigawatts to replace coal-fired power plants. This strategy would triple the world's current supply of nuclear energy.
- 4.) Wind power: Build 2 million windmills, each with an electricity-generating capacity of 1 megawatt, to replace some coal-fired power plants. Global wind-power capacity now stands at about 80 gigawatts, or 4 percent of this amount.
- 5.) Solar power: Build solar electric power plants with a peak ("sunny day" generating capacity of 2000 gigawatts. With today's technology, these power plants would need to cover at least 20,000 square kilometers (7719 square miles) of arid land surface.

6.) Carbon sequestration: capture and store underground the carbon dioxide produced by coal-fired power plants generating 800 gigawatts of electricity. In 2006, the total electricity-generating capacity of all U.S. power plants was about 1000 gigawatts.

7.) Reforestation: Eliminate tropical deforestation and rehabilitate 3 million square kilometers (1.16 million square miles) of tropical forests or 4 million square kilometers of temperate forests. The latter area is about half the size of Australia.

*Full reference is S. Pacala and R. Socolow, *Science* 305: 968-972 (2004). The seven steps outlined above were as summarized by Jordan and Grotzinger, *The Essential Earth*, p. 412