Homework Assignment #5: Energy Economics 399

Due: Wednesday, March 25

1. Suppose an electric power system has the following mix of generating capacity installed on its network which is owned by several competing generating firms (this is approximately the electricity mix of Massachusetts):

Type	Marginal Operating Cost	Capacity
Hydro	$0/Mwh	1,000 Mw
Wind/Biomass/Solar	$5/Mwh	500 Mw
Nuclear	$10/Mwh	1,500 Mw
Coal	$45/Mwh	1,000 Mw
Gas	$65/Mwh	4,000 Mw
Oil	$90/Mwh	2,000 Mw

   a. Draw the competitive supply curve for the production of electric energy on this system
   b. Assume that demand is completely price inelastic in the very short run. What would be the spot prices in a perfectly competitive wholesale electricity market at demands of 3,500 Mw, 5,500 Mw, 7,500 Mw, and 9,500 Mw?
   c. Assume that demand is 8,500 Mw at a price of $90, but that 600 Mw of this demand would be willing to be curtailed for a price of $50/Mwh or more. What is the perfectly competitive market price in this case?

2. Suppose an electric power system has the following mix of generating capacity installed on its network which is owned by several competing generating firms (this is approximately the electricity mix of Arizona):

Type	Marginal Operating Cost	Capacity
Hydro	$0/Mwh	1,000 Mw
Wind/Biomass/Solar	$5/Mwh	500 Mw
Nuclear	$10/Mwh	2,500 Mw
Coal	$20/Mwh	5,000 Mw
Gas	$65/Mwh	1,000 Mw
Oil	$90/Mwh	0 Mw

   a. Draw the competitive supply curve for the production of electric energy on this system
   b. Assume that demand is completely price inelastic in the very short run. What would be the spot prices in a perfectly competitive wholesale electricity market at demands of 3,500 Mw, 5,500 Mw, 7,500 Mw, and 9,500 Mw?
   c. Assume that demand is 8,500 Mw at a price of $90, but that 600 Mw of this demand would be willing to be curtailed for a price of $50/Mwh or more. What is the perfectly competitive market price in this case?
   d. The actual average residential consumer paid in 2007 was $0.0873/Kwh in Arizona and $0.1623/Kwh in MA. Why are the prices for electricity so drastically different in these two states?
   e. Where is the better place to use solar photovoltaic, Arizona or Massachusetts? Explain.

Homework #5: Page 2

3. Suppose state regulators in Arizona wish to deregulate the generation markets in Arizona. The transmission/distribution market will remain regulated.

   a. Suppose prior to deregulation the local utility generated its own electricity and had capacity as described in question 2. State regulators apply a cost plus method to determine the price the utility could charge equal to the average generating cost of the power plus 5 cents/Kwh to cover distribution costs. What will be the final retail price under this regulation scheme in the winter when the demand for power is 3,500 Mw and in the summer when the demand for power is 8,500 Mw?
   b. Why is this price inefficient in the short-run from an economic standpoint?
   c. Why is this price inefficient in the long-run from an economic standpoint?

   d. Now suppose the state regulators deregulate the generation market by requiring the utility to sell off their generation capacity and then requiring them to buy power the wholesale markets. The utility is allowed to charge final customers the wholesale price of the electricity plus 5 cents/Kwh to cover distribution costs. Assuming a perfectly competitive wholesale market, what will be the final retail price under this regulation scheme in the winter when the demand for power is 3,500 Mw and in the summer when the demand for power is 8,500 Mw?
   e. Why is this price efficient in the short-run from an economic standpoint?
   f. What long-run advantages does this regulation scheme have from an economic standpoint?

   g. Now suppose under the regulation scheme in part d. that instead of a perfectly competitive wholesale market in electricity, a single buyer has cornered 2,000 Mw of the coal generation market but that the rest of the wholesale electricity market remains perfectly competitive. What will be the final retail price under this regulation scheme in the winter when the demand for power is 3,500 Mw and how much revenue will the coal generator make per hour?
   h. What will be the final retail price in the summer when the demand for power is 8,500 Mw and how much revenue will the coal generator make per hour if the coal generator does not exercise its market power?
   i. What will be the final retail price in the summer when the demand for power is 8,500 Mw and how much revenue will the coal generator make per hour if the coal generator exercises its market power by removing 1,000 Mw of coal generation capacity during the summer for "routine maintenance."

   j. Suppose that summer demand is instead equal to 12,700 - 60P where P is the retail price per Mwh. Now much revenue will the coal generator make per hour if the coal generator exercises its market power by removing 1,000 Mw of coal generation capacity during the summer for "routine maintenance." How much electricity is demanded?

   k. During California's disastrous deregulation experience in the early 2000s, the electricity distributor was required buy electricity on what turned out to be not perfectly competitive markets, but in addition the regulator also placed a ceiling on the price the distributor could charge. Comparing your answers in parts i. and j., why was this such a terrible regulation scheme?