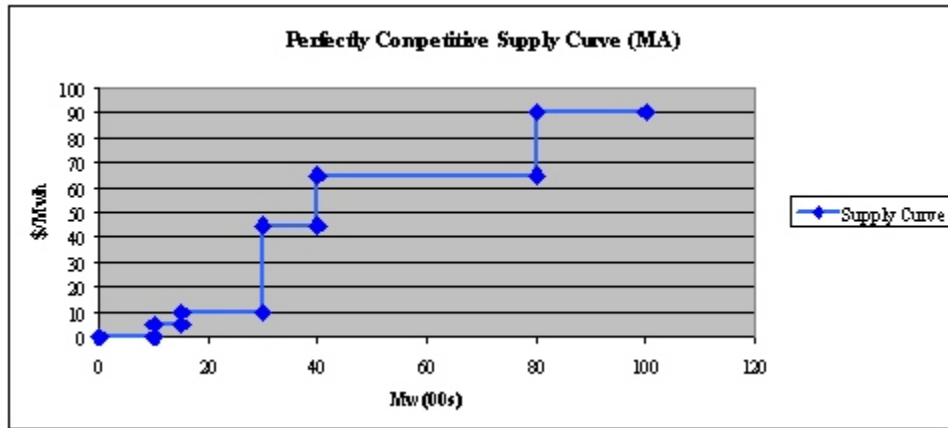


Homework Answer Key #5

Energy Economics 399

Associate Professor: Victor Matheson

1. a.



b. In each case, one uses the cheapest electricity first and then successively more expensive forms.

If demand = 3,500 Mw, P = \$45.

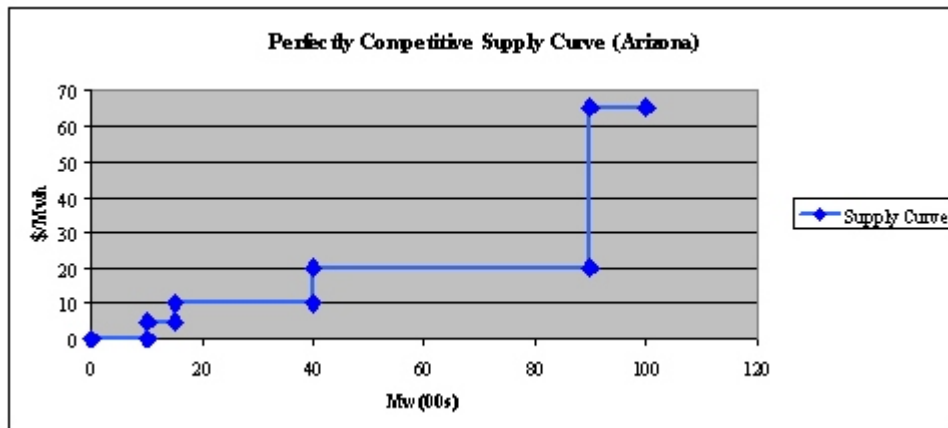
If demand = 5,500 Mw, P = \$65

If demand = 7,500 Mw, P = \$65

If demand = 9,500 Mw, P = \$90

c. In this case, instead of purchasing electricity at \$90, consumers will reduce electricity use by 600 Mw at a cost of \$50. This will reduce consumption to 7,900 and P to \$65.

2. a.



b. Again, in each case, one uses the cheapest electricity first and then successively more expensive forms. If demand = 3,500 Mw, P = \$10.

If demand = 5,500 Mw, P = \$20

If demand = 7,500 Mw, P = \$20

If demand = 9,500 Mw, P = \$65

c. At a demand of 8,500, the price would normally be \$20/Mwh. Therefore there is no incentive to reduce consumption at a cost of \$50.

d. Massachusetts relies much more heavily on expensive electricity generation sources like natural gas and oil than Arizona. Furthermore, coal-fired generators can supply electricity at a much

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lower cost in AZ than MA.

- e. While it is clear that solar cells will work more efficiently in a sunnier climate like Arizona, solar power has to compete with very cheap nuclear and coal electricity in that state. Thus, while solar potential is roughly 50% higher in Arizona, since electricity prices are twice as high in Massachusetts, solar power is actually at least as good a deal here.
- 3.
- a. The utility will utilize its cheapest sources of electricity first and then successively more expensive ones using the hydro, other renewable, and most of the nuclear. The weighted average marginal cost in the winter is $[0(1000) + 5(500) + 10(2000)]/3500 = \$6.43/\text{Mwh}$. 5 cents per Kwh translates into $1000(.05) = \$50.00$ per Mwh for distribution costs. Electricity will cost \$56.43 per Mwh or 5.64 cents per Kwh. In the summer, the weighted average marginal cost in the winter is $[0(1000) + 5(500) + 10(2500) + 20(4500) +]/8500 = \$13.82/\text{Mwh}$. Overall, electricity will cost \$63.82 per Mwh or 6.38 cents per Kwh.
 - b. This pricing scheme is inefficient in the short-run because consumers pay a price that is lower than the marginal cost of supplying the electricity. ($56.43/\text{Mwh} < \$10$ nuclear generating + \$50 distribution costs in the winter, for example.)
 - c. Any cost plus pricing scheme gives the utility no incentive to reduce costs since any costs can be immediately passed on to consumers.
 - d. In the winter, the perfectly competitive wholesale price for electricity will be \$10/Mwh leading to a retail price of \$60/Mwh or 6 cents per Kwh. In the summer, the perfectly competitive wholesale price for electricity will be \$20/Mwh leading to a retail price of \$70/Mwh or 7 cents per Kwh.
 - e. In both winter and summer, consumers are paying the marginal cost for their consumption of electricity.
 - f. Independent generators have the incentive to enter the market if they can produce electricity at a lower cost than existing plants which should lead to declining prices in electricity.
 - g. The coal generator cannot compete with lower cost hydro, other renewable, and nuclear in the winter, so the wholesale price is \$10/Mwh and the retail price is \$60/Mwh or 6 cents/Kwh. The monopolist sells no coal-fired electricity.
 - h. In the summer, the perfectly competitive wholesale price for electricity will be \$20/Mwh leading to a retail price of \$70/Mwh or 7 cents per Kwh. 4500 Mw of the 5000 Mw of coal-fired electricity will be used meaning that the monopolist will sell between 1500-2000 Mwh of electricity every hour at a price of \$20/Mwh for a total revenue of \$30,000-\$40,000/hour.
 - i. If the monopolist removes 1000 Mw of coal-fired power from the grid, the wholesale price will rise to \$65/Mwh because the state will now need to utilize gas-fired generators to meet demand leading to a retail price of 11.5/Kwh or \$115/Mwh. The monopolist will now only be able to sell 1000 Mw (because the other 1000 is "under repair") but will get to sell its remaining capacity at a price of \$65/Mwh for a total revenue of \$65,000/hour. Obviously, given the fact that coal plants are not utilized in the winter, routine maintenance should never be scheduled for the summer.
 - j. This is pretty hard. There are two price levels to consider. At a price of \$70, the market demands 8500 Mw which exceeds the amount that be provided at a price of 70 (= 8000 when 1000 of coal is idle). At a price of \$115, the market demands 5800 Mw which can be completely covered by non-natural gas sources. One solution is to set $8000 = 12700 - 60P \implies P = 78.33$, wholesale price = 28.33. The revenue to the monopolist is $1000(28.33) = \$28,333/\text{hr}$ which is less than they

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would generate without the market manipulation.

- k. The California system was a poorly thought-out regulatory framework. It gave producers the incentive to manipulate the system but also didn't give consumers any incentive to alter their behavior in the face of higher production costs. In part j, the market manipulation didn't work because electricity consumers cut their demand in the face of the artificially high prices. In part i, on the other hand, demand stayed constant even as prices rose from \$70 to \$115/Mwh. Therefore, the monopolist was able receive the higher price while still selling their remaining capacity.