Lecture – 25A&25B

Energy Resources, Economics and Environment

Revision paper

Rangan Banerjee
Department of Energy Science and Engineering

IIT Bombay

1.

Comment on whether the following goods/ services/ bads are rival/ non-rival, excludable/non-excludable, public/ private. Explain your answer. Marks will be given only with correct explanation.

a) Biogas Plant
b) Eastern Freeway
c) Urban Air Pollution
d) Cable Television

[1.5x4 =6]

1.
e) IITs charge ₹ 2 lakhs per year as the annual fees to students for Undergraduate education while the full cost of IIT education is about ₹ 6 lakhs per year. There is a proposal to recover the full cost of IIT education from students. Consider a society with 1% families containing IIT students. Would the proposal pass the Pareto condition? Or based on the Pareto compensation principle? If the society has to pay (a) an equal tax to bear the cost or (b) recover the full cost from the students, in the case of voting, which would be preferred? Provide an economic argument justifying continuing the subsidized fee to IIT students

[2]

2.

a) The supply curve for coal in a country is given as P=2500+ 5Q . The demand curve   for coal is given as P= 8500- 10Q where P is the price in ₹/ tonne and Q is the Quantity (in appropriate units say million tonnes annually). Plot the supply and demand curves and determine the equilibrium price and quantity. What is the consumer surplus and the producers surplus? - show these on the plot. What is an externality? In the case of coal production list some of the externalities. If the government decides to impose a carbon on all coal sold (₹ 500/ tonne) show the new equilibrium point. Is the tax efficient? Does it result in a change in the total surplus? What could be the justification for the carbon tax?   [5]

2.

b) Consider a decision being taken in your hostel to invest in a flower garden between two wings. The hostel has 300 residents – 100 residents have individual marginal willingness to pay p=100-2q (residents who have a direct view of the flower garden) where other residents (200 residents) have individual marginal willingness to pay p =60 –3q where q is the number of flowering plants and p the willingness to pay in Rupees. The marginal cost of supply of a flowering plant is constant at ₹ 150. Sketch the aggregate demand and supply curve and determine the optimal number of flowering plants. Is this a Lindahl equilibrium? Is this feasible to implement? What are the difficulties in implementing the Lindahl equilibrium?

[5]

3.

The inverse demand function for a fossil fuel is:

$P_t = 5 - 0.6 q_t$, Assume that the costs of extraction are zero. The initial reserves are $R_0 = 50$ and $d = 10\%$.

a) What is the price elasticity of demand for this function when $q_t = 4$?

b) Determine the time path of extraction for a mining industry under pure competition.

c) When does the resource get exhausted?

d) Would the time path of extraction for a monopolistic mining industry be different?

Explain your answer qualitatively

e) What is the effect of a higher discount rate on the path of extraction

[1+2+2+1+1]

Extraction path
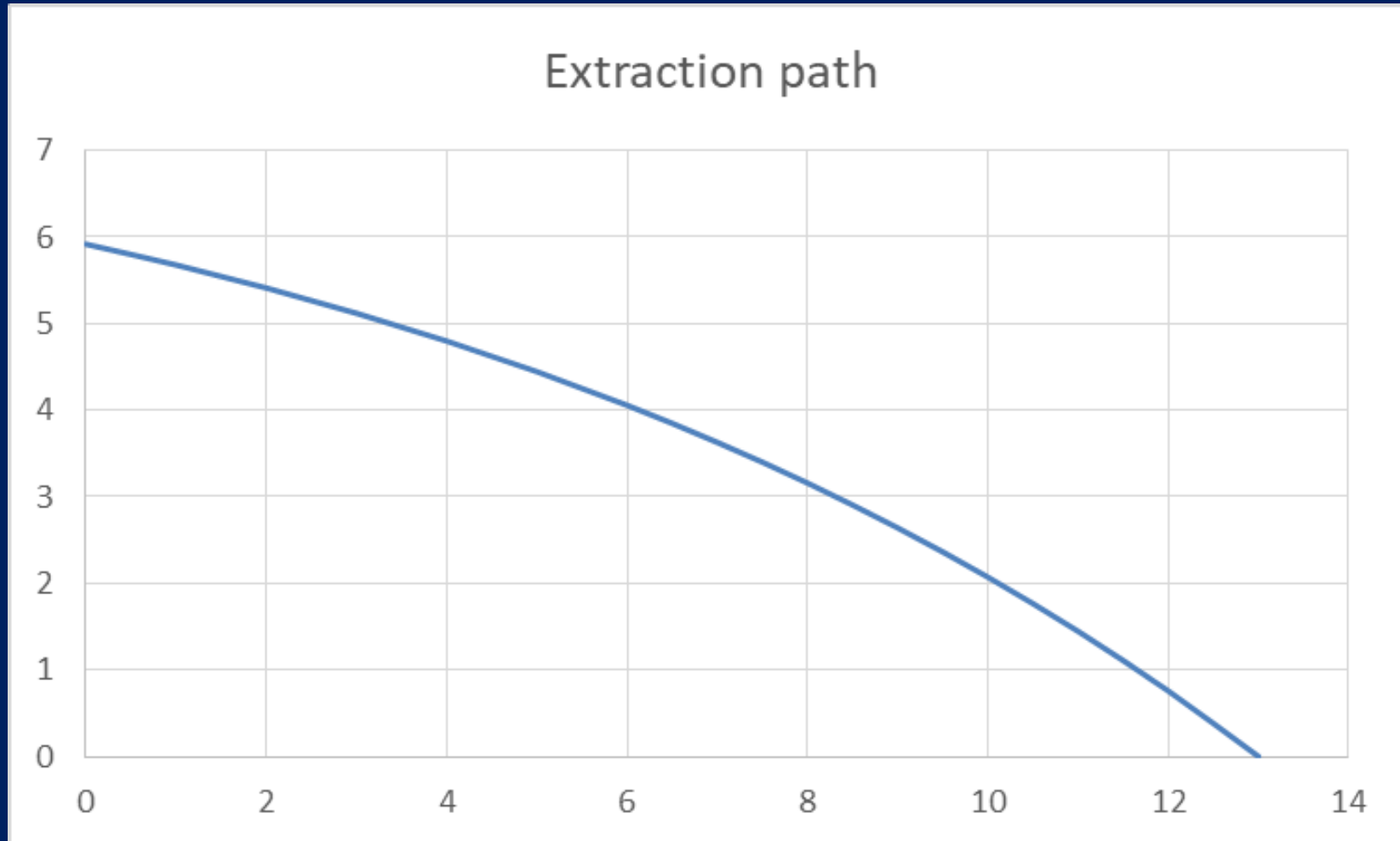
3.

f) A holiday resort is located in a remote area and is a popular tourist destination. An industry sets up a coal based power plant adjacent to this The holiday resort files a case in court to acquire property rights for having clean air (specified air quality) to restrain the power plant from polluting the air and affecting its business. If there are no transaction costs and there is complete information, from an economic viewpoint, comment on the possible impact of the court judgment – viz – whether the power plant wins the case and gets the rights to continue polluting the air or the resort wins the case and acquires property rights to a clean atmosphere – similar to the point when the coal based power plant did not exist (Assume that the power plant meets the pollution norms). Clearly explain your answer

[2]

4.

a) A developer has bid for a wind farm of 250 MW a tariff of ₹ 2.80/kWh for a period of 25 years. The capital cost is ₹ 1400 crores. If the O&M cost is ₹ 0.2/kWh and the annual capacity factor is 30% determine the internal rate of return on the investment. Show a few steps and obtain an approximate answer. The developer is being offered a loan of ₹ 700 crores with an interest rate of 10% and a tenor (term) of 10 years. Calculate the annual loan repayment amount. Determine the rate of return on the equity (show the cash flows in different years), form the equation for the IRR and show how you would calculate. Should the developer opt for the loan?

[5]

4.

b) The transactions in a state economy using electricity and industry are shown below (in Million Rupees)

	Electricity	Industry	Final Demand
Electricity	800	900	1500
Industry	1000	1200	3000

i) Calculate the total sectoral outputs and the direct technical coefficients- A matrix. What do A(1,2) and A(2,2) signify?

[2]

4.

b)

ii) Compute the Leontief inverse matrix L. If the final demand for industry increases by 5 % and the final demand for electricity remains the same, compute the changes in the total output of both the sectors   [2]

iii) If the average price of electricity is 4 ₹/kWh, what is the electricity intensity in industry in MWh/ Million ₹? What are the limitations of the Input –Output method?   [2]

c) What is Net Energy Analysis? How would you compute the Net energy required for a bio fuel?   [2]