Energy Economics and Technology

Energy Economics

Question 1

Exhaustible and renewable resources have a demand of P=8-0.4Q with marginal extraction cost 2 and marginal cost of recycling 1.25+0.1q(rec). The maximum availability is 34 and we have 2 periods. A social planner wants to maximize total welfare.

a) Will recycling occur, why (not)? (*if we calculated the price without recycling, then the price level was below the cost of recycling, so not interesting to start recycling: q1=q2= 17 and p1=p2=1.2 < 1.25)*
b) Due to R&D efforts, the cost of recycling decreases. What changes? (*recycling becomes interesting, see equations in chapter 2 for the quantities extracted in each period and quantity recycled and price:)*
c) Even if you did not solve the numerical problem in part b you can give qualitative analysis on what the implications are *(lower cost of backstop technology, so initial price decreases and faster exhaustion?)*

Question 2

Court files ruling against Dutch oil company Shell to limit its carbon emissions to 45% of 2019 values. How do you assess this judge's ruling based on what we saw in the course?

Question 3

OPEC(supply) = 2*(p-10)
OPEC+(supply)=5*(p-10)
MC(CF) = 10+0.8Q(CF)
Demand=0.5*(240-p)

a) OPEC+ is the dominant player. There is a competitive fringe CF. Total demand function given. Supply function of OPEC+ , supply function of OPEC and MC function of competitive fringe given. Solve the problem to find equilibrium price and quantity.
b) Now, there is a dispute between OPEC and the 'plus' countries. The 'plus' countries leave OPEC+ and join the competitive fringe. Calculate the impact. *(Use OPEC supply function for the dominant supplier, and add 'plus' supply function to the competitive fringe. This is like the breakdown of a cartel, so prices drop and quantity increases?).*

Energy Technology

Question 1

Rankine cycle with superheating. Give all enthalpies and entropies at state 1,2,3,4,5,6.

Question 2

1 wind turbine has CF of X% and rated power of Y. Thermal power plant has CF of Z% and rated power of Q. How many wind turbines are needed to provide as much... as the power plant?

Question 3

Solar irradiance of 200 kW/m^2.

a) What is yearly solar radiation?
b) How much m^2 PV panels needed to foresee for average yearly household electricity consumption (data not given and needs to be retrieved from the slides)?

Question 4

3 phase induction motor of premium efficiency. Mechanical power X. 230V/400V

a) Estimate the efficiency
b) What is active electrical power (motor transfers electrical power into mechanical power)
c) if cos phi is 0.85, calculate the currents of the stator windings
    i) if star
    ii) if delta
    (should be the same?)
d) if cos phi is 0.85, calculate reactive and apparent power

Question 5

Resistor connected with DC voltage source.
Heat dissipation of X during 2 minutes and current of .. ampère.

a) calculate the DC voltage source
b) what is the value of the resistor
c) how much power does the resistor consume
d) horsepower

Question 6

Exercice with first law in an open system. Plug the data in the equation. Beware of conversion units.