Energy Resources and Policy

Assignment:
Wind Energy

First, find the value of N, the position in the English alphabet of the letter which begins your family name (for Anderson N = 1, for Brown N = 2 *etc*.).

At the proposed site for an offshore wind turbine, the velocity exceedence curve is approximated by the equation

$$V_\infty \, T^{0.5} = 60$$

where V_∞ is the wind speed (m/s) and T the number of days in a typical year when the mean wind speed exceeds V_∞.

The selected turbine has a rotor diameter of 94 m, a cut-in wind speed of 4 m/s, a rated speed of [10 + 0.2N] m/s and a cut-out speed of 24 m/s. It may be assumed that between cut-in and rated speeds the turbine operates at a fixed power coefficient of 0.42, and that above the rated speed the power remains constant until cut-out is reached.

The total cost of the turbine, including foundations and electrical connections, is given by £[2 + 0.025N]x10^6. If this money is borrowed from a bank, the annual repayment required is given by

$$\frac{C\, r\, (1 + r)^n}{(1 + r)^n - 1}$$

where C is the value of the capital loan, n the number of years to complete the repayment and r the rate of interest on the loan.

Part A

Calculate the total amount of energy captured (kWh) by the turbine in a typical year of operation, and determine its capacity coefficient. Assume an air density of 1.21 kg/m^3.

Assuming a 15-year repayment period and an interest rate of 6%, calculate the cost of electricity (in pence per kWh) from the turbine during its first 15 years of operation. Include an annual cost for maintenance of 3% of the capital cost of the turbine.

Carry out a sensitivity exercise to determine the impact on the electricity cost of changes in maintenance cost, the length of the repayment period and interest rate.

Comment on the implications of all results obtained.

Part B

What are the principal issues confronting offshore wind energy, how will these, in you opinion, limit its future potential and what might be done to mitigate any limitation?

The report should contain full details of all calculations (no spreadsheet need be submitted). A discussion of at least 600 words is required in response to the questions posed above. The submission deadline will be announced on the class Website.

External sources of information should be referenced in the usual way (but will not count against your word limit). You are reminded of our regulations about plagiarism – by all means refer to published articles on the subject, and quote from them if you wish. **But this article must be your own work and express your own considered views.**