

UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualification:–

M.Sc.

ESGE1: The Built Environment: The Energy Context

COURSE CODE : ENVSGE01

DATE : 17-MAY-04

TIME : 14.30

TIME ALLOWED : 2 Hours

UNIVERSITY OF LONDON

MSc DEGREE in SCIENCE in BUILT ENVIRONMENT 2004

for Internal Students of University College London

Module ENVS GE 01: BUILT ENVIRONMENT: The Energy Context

Answer TWO questions only. Answer all parts of the questions chosen.

1. (a) Explain the difference between useful, delivered and primary energy. (9 marks)
 - (b) Give two possible explanations how the use of energy in a building can increase at the same time as carbon dioxide emissions reduce. (8 marks)
 - (c) List three possible changes in the future use of energy in dwellings in the UK. (6 marks)
 - (d) Microwave cooking has resulted in a significant reduction in the delivered energy required to cook food. It could be possible to envisage a similar microwave heating system which would warm people in buildings. If microwave heating of people in buildings did not create potential health problems, explain the possible benefits and disbenefits of this form of heating, compared to the more conventional central heating system from water filled radiators. (20 marks)
 - (e) Why are the predictions for climate change for the next two decades not significantly affected by carbon emissions resulting from energy use in buildings. (7 marks)
2. (a) Explain why producing electricity from wind turbines is considered environmentally friendly. (10 marks)
 - (b) Why is electricity generated from wind referred to as "renewable" energy. (5 marks)
 - (c) Explain the following terms: "cut-in wind speed", "rated wind speed", "rated power", "shut-down wind speed" and "solidity" for a wind turbine. (10 marks)
 - (d) Discuss the issues associated with wind power, which mean that in the future it will be unlikely to make-up more than 20% of the UK's total electricity generation. (5 marks)
 - (e) **Figure 1** shows the "wind-speed/power" curves for two wind turbines, A and B, which will be erected on the same site. **Figure 2** shows the "wind speed frequency distribution" curve for that site. Which of the two wind turbines will generate more energy and by how much? Comment on the suitability of each turbine for that particular site. (20 marks)

TURN OVER

3. (a) Explain the physical principles behind the generation of electricity from solar radiation using photovoltaic (PV) cells. Illustrate your answer with diagrams and sketches. (10 marks)
- (b) There are a number of factors which affect the electrical output of PV cells. List as many of these as you can, then briefly discuss how each affects the output of the cells. (15 marks)
- (c) Photovoltaic cells arranged in arrays and mounted on buildings can generate substantial amounts of electricity. Describe a building which uses PV cells to reduce its dependence on electricity bought from the national grid system, and discuss the way in which the arrays have been integrated into the building. Discuss the advantages and drawbacks of this technology applied to buildings in the UK and northern Europe. (20 marks)
- (d) Discuss the issues which are currently holding back the development of this technology for both domestic and commercial buildings in the UK. (5 marks)
4. (a) Some people believe that developed countries are increasingly moving towards a very short term view of the future, in that, they do not seem to plan for, or value the future. Explain how valuing and planning for the future can be taken into account when comparing the net present cost (NPC) of different technologies. (10 marks)
- (b) If a new type of photovoltaic (PV) array was discovered which cost only £100 per square metre to manufacture and install, and which converted 10% of the incident solar energy to useful electricity, calculate the following:
- i) the payback period of the PV array (10 marks)
 - ii) the NPC of the PV array over a 10 year period. Compare this with the NPC of using conventional grid based electricity. (25 marks)

For the location of the PVs, assume the following in the calculations.

- The annual average (day and night, summer and winter) incident solar energy is 100 W/m^2 .
 - The average cost of mains generated electricity is £0.07 per kWh
 - The lifetime of the PV array is 25 years.
 - The social discount rate is 0.1
 - The fuel inflation rate is 0.
- (c) What recommendation would you make to a potential investor in the technology of part (b). Why? (5 marks)

END OF PAPER

FIGURES 1 and 2 ATTACHED

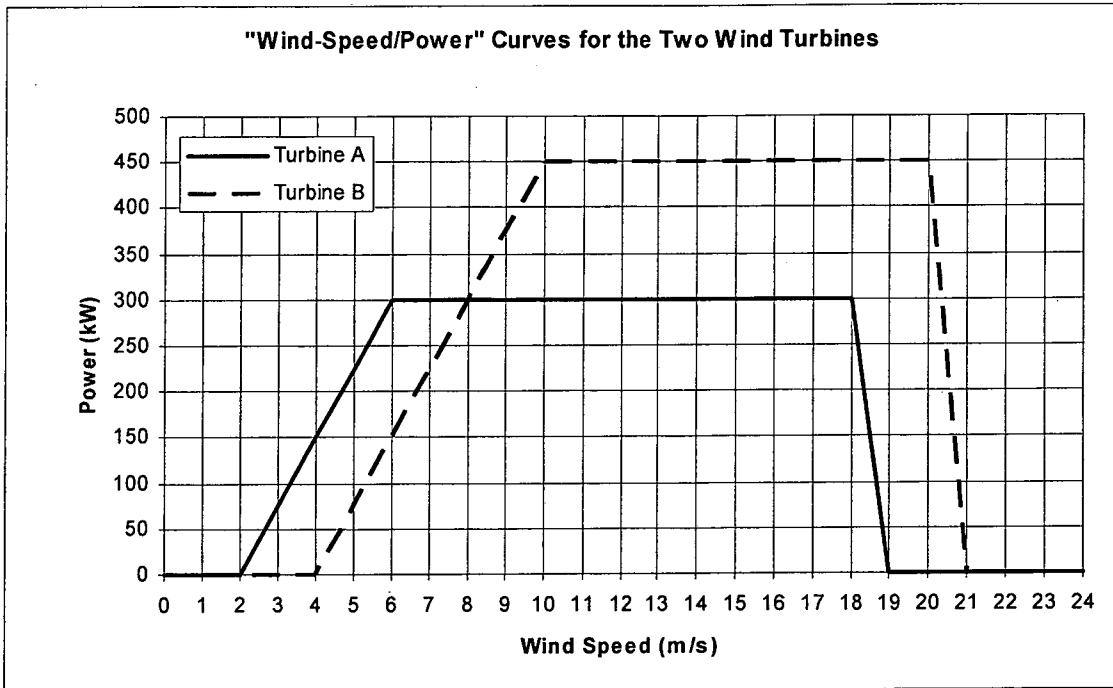


Figure 1: "Wind-Speed/Power" Curves for the Two Wind Turbines

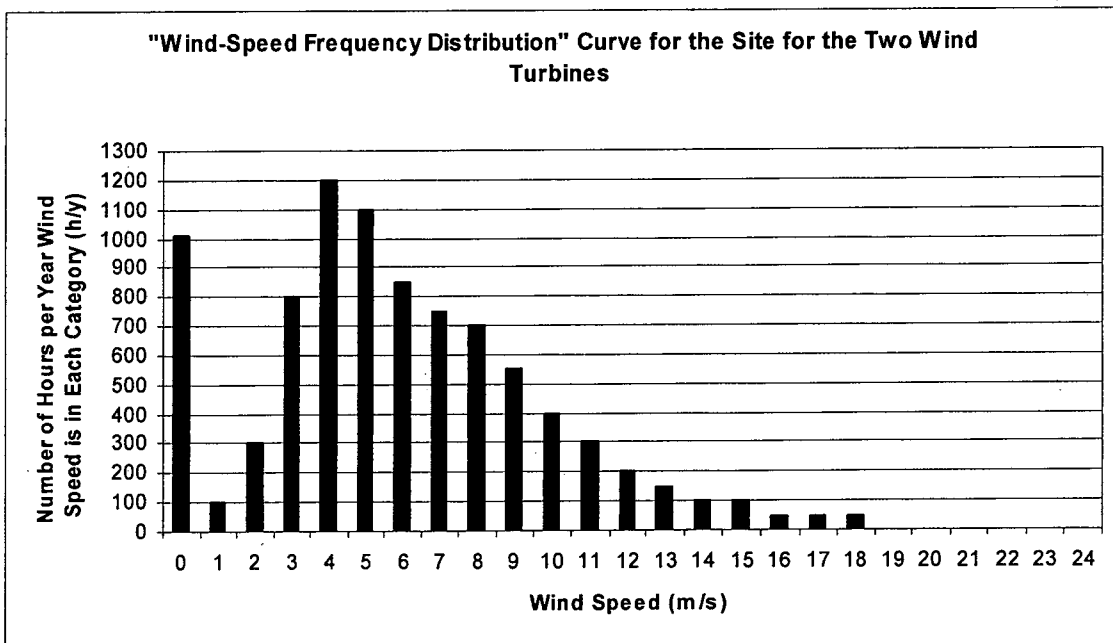


Figure 2: "Wind-Speed Frequency Distribution" Curve for the Site for the Two Wind Turbines