Wind Energy – A Level: Student activities – 2024.

1. **Formation of wind:** Using slides 2 and 3,
    a. Describe how wind is created in the earth's atmosphere.
    b. Explain what factors affect wind strength.

2. **Electricity from Wind energy:** Using slide 4, 5 and 7, plus your notes from the video, explain how electrical energy is generated from the wind by a wind turbine.

3. **Location of wind farms in the UK: Using slide 6, Figure 1**
    a. describe the pattern of average wind speeds in the UK.
    b. suggest at least two reasons for the pattern shown.
    c. Explore the way wind speeds vary around the UK and Western Europe by looking at the Global Wind Atlas. https://globalwindatlas.info/en

4. **Development of Wind Turbines:**
    a. Referring to slide 8, summarise how wind turbines have developed since 1980?
    b. Using slide 9, explain why wind energy is considered to be a renewable energy source when compared to fossil fuel sources of electricity such as natural gas, coal and oil.

5. **Wind Energy in the UK.** Using slide 10:
    a. Explain the importance of renewables including wind energy in the UK energy mix and how it has changed since 2000.
    b. Suggest reasons why is it still necessary for a country like the UK to have gas fired power stations in its energy supply mix, alongside wind energy?

6. **Where is wind energy generated in the UK?** Using slide 11 and slide 6:
    a. Give reasons for the location of

        (i) onshore wind farms and

        (ii) offshore wind farms in the UK
    b. Referring to an atlas or internet map of population distribution in the UK, suggest how the location of wind farms relates to centres of population.

7. **Building a wind turbine:** Using slides 12 and 15, summarise briefly the materials needed to make a wind turbine.

8. **Wind Farm end-of-life options**. The standard design lifetime of a Wind Turbine is at least 20 years according to the International Electrotechnical Commission standard. (IEC 61400-1). For many Wind Farms in the UK, the original planning permission was for only 25 years. Several wind farms will be approaching the end of their designed life in the period 2025 to 2035.
    a. Using the statistics in slide 16 and 17, explain why it is important to plan for the end-of- life options for the 11700 wind turbines currently operational in the UK.
    b. Using Slides 19 to 23, summarise the three current options for wind farms as they approach their end-of-life (Life-extension, Repowering and Decommissioning)

9. **Wind energy and the circular economy.** The circular economy model (slide 24) aims to use less raw materials, produce less waste and create fewer emissions. Using Slides 25 to 30:
    a. Briefly summarise how the circular economy model could be applied to wind turbine design and construction.
    b. Using examples, describe how the components of a wind turbine can be recycled.
    c. Explain the problems of fully recycling all the components and structural elements such as foundations of wind turbines.
    d. Produce a table to show the advantages and disadvantages of each of the three options.

Case study and decision-making exercise: The accompanying worksheet provides a case study of the Kirkby Moor Wind Farm in Cumbria, and a decision-making exercise.

Extension activities – going further.

1. **Research task:** Explore the Energy Dashboard on the internet. Energy Dashboard - real time and historical GB electricity data, carbon emissions and UK generation sites mapping
    a. Summarise how energy is being generated at present.
    b. Suggest why this varies from day to day and month to month.
    c. Explore how this has changed over the last 20 years.

2. **Research task:** Using research from the internet and other sources, explain why the decommissioning of a wind farm can cause problems. Use the following headings:
    a. Effects on the local ecosystem
    b. Effects on the local community (noise, intrusion)
    c. Difficulties concerning where and how materials can be recycled or reused.

3. **Research task: Offshore wind farms.** Research one named offshore wind farm that is approaching its end-of-life date using the internet. (UK or in Europe). For your chosen wind farm, assess the strengths and weaknesses of the following three options.
    a. Life-extension
    b. Repowering
    c. Decommissioning

4. **World pattern of use of wind energy**. Study Figures 1 and Figure 2.



Figure 1: Top 10 Countries by Wind Capacity. Source: [Top countries with the most wind power capacity in the world – MAP | UK | News | Express.co.uk]

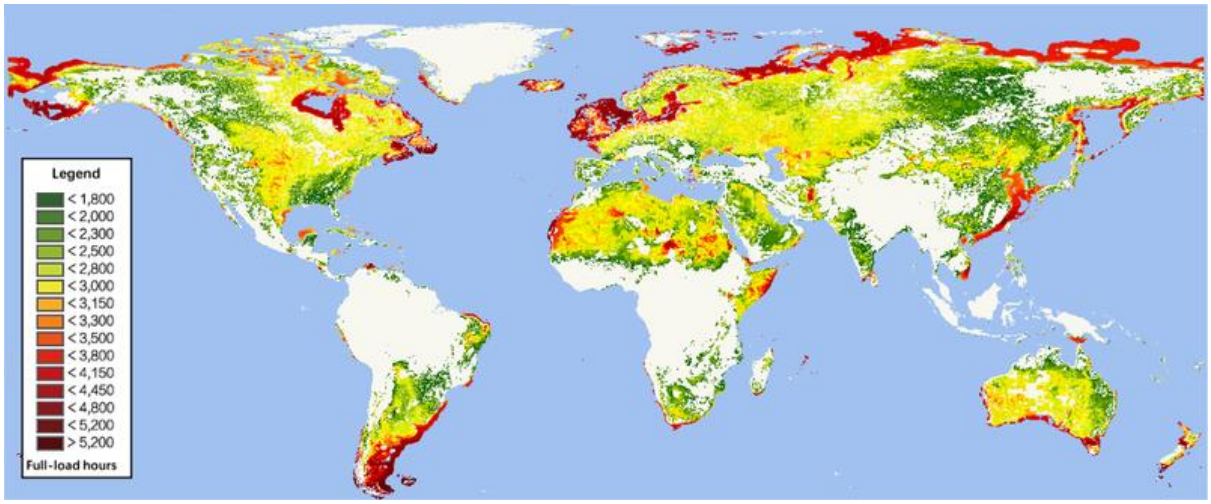


Figure 2: Distribution of global technical available areas for wind power generation and their full-load hours
Source: [Distribution of global technical available areas for wind power… | Download Scientific Diagram (researchgate.net)]

a. Analyse the data in Figures 1 and 2
b. Using figures 1 and 2 and your own knowledge, suggest reasons why some areas of the world available for wind power generation have not been developed to their full potential.

5. **Essay question.** How far do you agree that the generation of electricity from wind is a long-term sustainable energy option, as a part of a country's energy mix?

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