Windpower, Areas, Proportions

Physics and Mathematics of Sustainable Energy

College of the Atlantic. 5 October 2021

1. You are planning a party and have determined how much pizza you need to make. At the last minute you learn that 20% more people will be attending your party? How much more pizza do you now need to make?

2. Suppose you have a pizza of a certain area. If you double the radius of the pizza, what happens to the pizza's area?

3. Suppose you have a pizza of a certain area. If the radius of the pizza increases by 10%, what happens to the pizza's area?

4. Suppose you have a spherical balloon of a certain volume. If the radius of the balloon increases by 10%, what happens to the balloon's volume?

5. Suppose that a certain wind turbine generates a certain amount of energy per month. What would happen to the energy generated per month if:

   (a) The diameter of the blades was increased by 10%?
   (b) The turbine was re-located someplace where the average wind speed was 10% higher?

6. Residential electricity use in Maine is 21 billion kWh/year. What area of land would be needed to generate this electricity from terrestrial windpower?

   (a) Answer in square meters, square kilometers, square miles, and acres.
   (b) A square of what side (in km or miles) has this same area?
   (c) If this amount of electricity was generated using existing methods, how much CO_2 would be released into the atmosphere? Express your answer in tonnes per person.

7. First Wind claims that the 34 MW of wind capacity at its Bull Hill wind installation is sufficient to power 15,000 Maine homes. Does this seem right? The average Maine home uses around 520 kWh per month.[1]

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[1] http://www.businesswire.com/news/home/20111115006743/en/Wind-Announces-Agreement-Vestas-Purchase-77-V10 8, http://www.thewindpower.net/windfarm_en_16013_bull-hill.php.