

Windpower, Areas, Proportions

Physics and Mathematics of Sustainable Energy

College of the Atlantic. September 23, 2019

- 6400 kWh is how many MWh?
 - How many GWh is 356,000 kWh?
 - 10.5 MJ is how many Joules?
 - The total yearly electricity use for Maine is roughly 30 billion kWh. Express this per capita. (Maine's population is about 1.2 million.)
- Suppose it takes faculty member a certain chunk of time to write narrative evaluations for a certain class. If that class had 50% fewer students, what happens to the time taken to write evaluations? What would happen if that class had twice as many students?
- 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?
- Suppose you have a pizza of a certain area. If you double the radius of the pizza, what happens to the pizza's area?
- 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?
- 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?
- Suppose that a certain wind turbine generates a certain amount of energy per month. What would happen to the energy generated per month if:
 - The diameter of the blades was increased by 10%?
 - The turbine was re-located someplace where the average wind speed was 10% higher?
- Residential electricity use in Maine is 21 billion kWh/year. What area of land would be needed to generate this electricity from terrestrial windpower?
 - Answer in square meters, square kilometers, square miles, and acres.
 - A square of what side (in km or miles) has this same area?
 - If this amount of electricity was generated using existing methods, how much CO₂ would be released into the atmosphere? Express your answer in tonnes per person.
- A 3 MW turbine produces 10 GWh in one year. What is the turbine's capacity factor?
- A 1 GW coal power station operates for one year at a capacity of 90%. How much energy does it produce in one year?
- 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

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.