WIND STUDY

Wind Study is intended for grades 5-8 and 8-11
Questions posted on: Monday Answers posted on: Friday
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2021Q19 (YAW, ENERGY EFFICIENCY OVER TIME)

Although wind flow has patterns and precedence, it can always blow from any direction; how do One Energy's wind turbines keep up? They change their yaw. Yaw is an axis of rotation that changes the direction the turbine is facing. Think about yaw like the times you turn your head to look around without moving your body. The angle of rotation is measured in degrees. For example, 180° is one half of a rotation, and 360° is one total rotation. Our wind turbines rotate to face directly into the wind and capture wind energy more effectively. They can even rotate in two complete circles for a total of 720° of rotation (much further than your head can turn!). However, this yaw motion comes at the cost of spending energy to engage the yaw motors.

Here, you can see that the turbine in the foreground is yawed to face away from the camera; the turbine in the background is yawed to face the left of the picture. This difference in yaw can be caused by a variety of factors.

Level 1: To face into the wind, one of our 1.5 MW turbine yaws 13.38°. An entire rotation of the turbine takes about 780 kWh of energy. How much energy did this 13.38° yaw consume?

Level 2: Before this rotation, our turbine produced 97% of its total possible power output. Following this, our turbine did not have to yaw for 12 hours.

a. Calculate the energy output of the turbine for the 12 hours after the yaw. To get the net energy of this 12 hours, subtract the energy consumed during the yaw rotation.
b. Now, assume that the turbine did not yaw. How much energy did the turbine produce in this scenario?
c. What is the net energy benefit of the yaw i.e. what is the difference between those two values?