

# A Windpower Exploration

## Physics and Mathematics of Sustainable Energy

College of the Atlantic. January 26, 2021

### Instructions

- Work with one or two other people. Please do not work in groups larger than three.
- This problem will be most of your homework for this week. This will be due this Friday, January 29. I'll make an assignment in google classroom and you can upload it there.
- Please write up your solutions relatively neatly, but there's no need to type this up, unless you want to.

In this problem we're going to investigate the Bethel Wind Farm located just to the west of Dimmitt, Texas. Find the Bethel Hill Windfarm on this website: <https://www.eia.gov/state/maps.php>. To do so, you'll need to zoom in on the Texas panhandle. Dimmitt is southwest of Amarillo and is pretty close to the New Mexico border. Once you find it, click on the large wind icon in the middle.

1. What is the nameplate capacity of the wind farm?
2. How much energy did it generate in 2019? To answer this question, click on "View Data in the Electricity Data Browser". (Don't add up the monthly totals! Click on the "Annual" button.)
3. Calculate the 2019 capacity factor for the Bethel Wind Farm.
4. What is the average power delivered by the windfarm?
5. Find the windfarm on the satellite view on google maps. It might take a little hunting around. (If you want, you could try bing maps, which seems to have a clearer satellite view.) Once you find the wind farm, use the "measure distance" feature (on either google or bing) and determine the area of the wind farm.
6. Calculate the power density of the wind farm. Express your answer in  $W/m^2$ .
7. Take a moment and explore the region with google maps. What is going on in this region? Do you think the wind turbines are harming the aesthetics of the area?
8. The average household in Texas uses 1200 kWh of electricity a month. Convert this to kW.
9. Amarillo, Texas is a city of around 200,000 people not far from Dimmitt. Assuming three people per household, what is the average power used by all of Amarillo?
10. Could the Bethel wind farm power all of Amarillo?

BTW, I got curious and looked up COVID rates for Castro County, Texas, which is the county that Dimmitt is in. Info about Castro Co. and Hancock Co., Maine, can be found here:

- Hancock County, Maine: <https://bao.arcgis.com/covid-19/jhu/county/23009.html>
- Castro County, Texas: <https://bao.arcgis.com/covid-19/jhu/county/48069.html>

Why might there be such a difference in the per capita COVID rates between the two counties? (There's no need to write anything up. I just thought this might be interesting to think about.)