Physics 162; Spring 2021
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Project 2: Wind Potential

Goals: We've learned how electricity generation from wind power works. We've also made some simple estimates of potential wind power – in other words, how much we could possibly tap, in principle. Let's build on all these things and compare some regions of the country and the world.

Groups: You are encouraged (but not required) to work in groups of up to three students. Feel free to use the Discussion board to find classmates, and feel free to work in the same group as Project 1.

Due date: Wednesday May 12, by 5:00 pm, **via Canvas**. No late assignments will be accepted. Submit your assignment as one PDF. Clearly indicate all group members' names.

Wind Power Potential Assessment

For various states, as detailed below, you'll calculate a very rough estimate of the possible power we could get from wind, just like we did in class for the state of Oregon. *Make sure you can repeat on your own the Oregon estimate, getting the same result!*

- To assess wind speeds in some area, use the Global Wind Atlas (https://globalwindatlas.info/), which lets you draw a polygon in which to evaluate regions.
- The maximum polygon area allowed is 250,000 km^2, so for large states you'll have to combine results from a few regions. Note that this doesn't have to be very exact!
- The Wind Atlas show the average wind speed at 100 m height for windiest 10% of the selected region.
- Be sure to consistently **use SI units.** Also note that M = Mega = 10^6, and G = Giga = 10^9.

Actual wind power:

- To find the *actual* wind power generation output of a state, use the same U.S. Energy Information Administration site and 2019 data we used in Project 1, but of course for the "Wind" part of "Total Electric Power Industry" For Oregon in 2019, for example, it is

2019	**OR**	Total Electric Power Industry	Wind	6,568,889

Note that it's about 6.6 **million MWh** in 2019, or about 6,600,000 MWh/year, which you can convert to GW.

Sources

You're welcome to use other data sources if you want. If you use sources other than those I list here, cite them in your writeup.

Part 1: States

Group A: WA, UT, ID
Group B: TX, OK
Group C: GA, FL, SC, AL

Pick one state each from groups A, B, and C, and pick **two** other states. Pick states that don't border each other.

1.1 Calculate (15 pts.)

For each state, calculate the following and **write your results in a clear table.**

a) The power that state could get from wind power, in GW, if the windiest 10% of the state is covered in wind farms.
b) The same, but 10% of that number – in other words, if we built wind farms in $1/10^{th}$ of the windiest 10% of the state, what power would we expect?
c) If the area used in part (b) is a square, how long is one side of the square, in **miles.** (In other words, one tenth of 10% of the area of the state is a ___ x ___ square; fill in the blank.)
d) Express the answer to (b) as power per person for that state, in kW.
e) From the EIA table, note the 2019 wind power generation of that state, in GW...
f) ... and the 2019 wind power generation per capita, in kW

1.2 Comment (6 pts.)

In a few sentences, comment on your results. Are the states similar, or different? Which of them currently uses the greatest fraction of its potentially available wind power? Do any of the states use more than 10% of the power available in the windiest 1% of their land?

Part 2: Other Parts of the World

(12 pts.) Explore the world using the Global Wind Atlas. Choose two regions, in two different continents, and estimate the available wind power as above. Also, by considering the populations of states or cities, estimate the population in each region, and the per capita power available. At least one of your regions should be within 300 miles of a city of more than 1 million people. Clearly explain your findings with both a table and text.

Other scoring

General clarity: 10 pts.