

Explorations: Solar and Otherwise

Physics and Mathematics of Sustainable Energy

College of the Atlantic. February 9, 2021

Instructions

- Work with one or two other people. Please do not work in groups larger than three.
- This problem will be a portion of your homework for this week. This will be due this Friday, Feb. 12. I'll make a separate 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 these explorations you'll investigate at least two power generation facilities: one solar PV array and one nuclear power plant. To do so, use this website: <https://www.eia.gov/state/maps.php>. Note that once the map has loaded, you can unselect things by opening the "Layers/Legend" menu up top. This will make the map less cluttered.

You should investigate two facilities:

1. A solar PV installation. There are a lot to choose from. You'll need to find the installation on a map, so select an installation that is at least a few years old, so it appears on google or bing maps.
2. A nuclear power plant. There are several dozen to choose from, mostly in the east and midwest.

For each of your power stations, record or calculate the following:

1. What is the nameplate capacity of the power station?
2. How much energy did it generate in 2019? Click on "View Data in the Electricity Data Browser". (Don't add up the monthly totals! Click on the "Annual" button.)
3. Calculate the capacity factor.
4. Calculate the power delivered by the power station.
5. Find the power station on the satellite view on google maps or using bing maps. Use the "measure distance" feature to determine the area taken up by the power station.
6. Calculate the power density of the power station. Express your answer in W/m^2 .
7. Optional: Take a moment and explore the region with google maps. What is going on in this region? Why do you think the power station is located where it is?
8. Enter your findings on this google spreadsheet: <https://docs.google.com/spreadsheets/d/1mk7sZfBNx3-59XxSS916AweIHGv7R1jsYax0f7VjNYA/edit?usp=sharing>. (You'll need to be logged in to your COA google account to access it.)

Once you have done the above analysis, answer the following questions:

1. How many homes could the nuclear power plant supply with electricity. (Use the use average of roughly 900 kWh per month.)
2. Using the power density you calculated for your solar PV installation, how large would a solar array need to be to power as many homes as the nuclear power plant? Express this area in a meaningful way.