

Homework Four

Physics and Math of Sustainable Energy

College of the Atlantic

Due Friday, October 7, 2022

There are two parts to this assignment.

Part 1: WeBWorK. Do Homework 04 which you will find the WeBWorK page here: <https://webwork.runestone.academy/webwork2/coa-feldman-es1056i-fall-2022/>. I recommend doing the WeBWorK part of the homework first. This will enable you to benefit WeBWorK's instant feedback before you do part two.

Part 2: Problems from the Textbook. Here are some instructions for how to submit this part of the assignment.

- Do the problems by hand using pencil (or pen) and paper. There is no need to type this assignment.
- If you like working on a tablet, go for it.
- Make a pdf scan of your work using genius scan or some similar scanning app. Please make the homework into a single pdf, not multiple pdfs.
- Submit the assignment on google classroom. Please don't email it to me. (Between my two classes I will be receiving around 60 assignments a week. Keeping track of them all in email is challenging.)

The problems you should do are from **Chapters 18 and Appendix C** of the book:

Chapter 18

1. 18.9
2. **Optional:** 18-5–18.18. These problems lead you through a derivation of the Betz Limit. Recommended for folks who want a modest physics/math challenge. (Disrecommended for everyone else.)
3. And here's a Chapter 18 problem that's not in the book yet... This problem is about the Bethel Windfarm, which is a few kilometers to the West of Dimmitt, Texas, USA.
 - (a) Find the wind farm on google or bing maps, and use the mapping tool to estimate the area of the wind farm. I think bing might be easier to use than google, since the picture is a little clearer. Express your area in km^2 .

- (b) What is the nameplate capacity of the Bethel Wind Farm? To answer this, go to this website <https://atlas.eia.gov/apps/all-energy-infrastructure-and-resources/explore>, which is a map of basically all US energy infrastructure. Find the Bethel Wind Farm. Click on the turbine icon, and a pop-up window will appear with two pages of info. Click to the second one, and you will see information about the windfarm.
- (c) How much energy did the wind farm generate in 2021? On the info tab on the previous website, you will see “View Data in the Electricity Data Browser” on the top. Click on the link. You will then be sent to a page that has information about the electricity generated by the wind farm. Do not add up the monthly totals by hand. Click on the “annual” tab and the website will do the addition for you.
- (d) What is the capacity factor of the Bethel Wind Farm?
- (e) What is the power density, in W/m^2 , of the Bethel Wind Farm?

Appendix C

1. C.9
2. C.11

Information about how to access the book and your WeBWorK account is also included on the pinned post on google classroom.