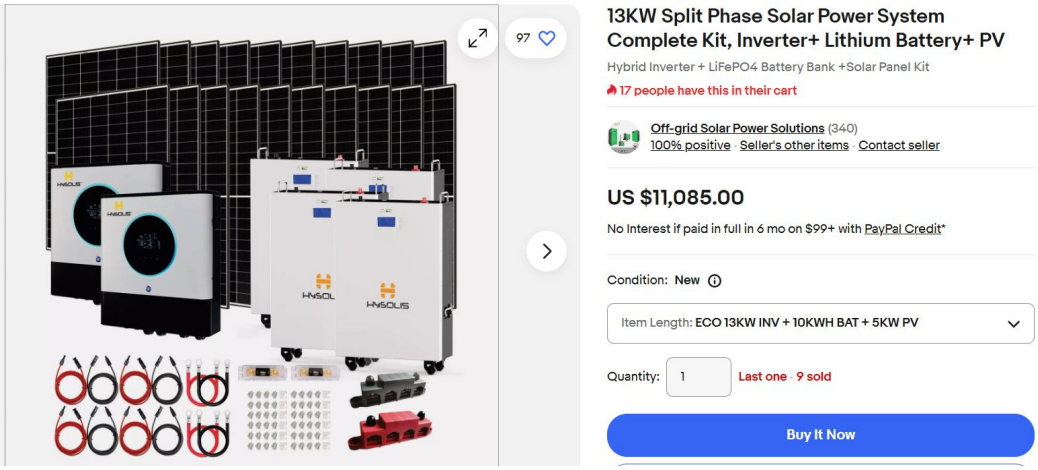
ECE 111 - Homework #5:

Renewable Energy
Due Monday, February 17th. Please submit via email or on BlackBoard

Solar Energy

A 13kW split phase solar power system with a 20kWh battery sells on ebay for $11,085 (January 5, 2025). Is this a good buy?



1) Load 4-weeks worth of solar energy data from NDAWN. (any town in North Dakota or Minnesota). Plot this in MATLAB as wind speed vs hour.

- Month = September or March (around the equinox - kind of a fair date)
- https://ndawn.ndsu.nodak.edu/
- Hourly Data
- Solar Radiation - Total (MJ/m^2)

Plot the solar ratiation vs. hour in Matlab

2) Calculate the kW generated each hour for the array

- 32 panels
- Each panel has an area of 2.00 square meters
- Panel efficiency = 20.5%

Plot the energy produced on an hourly basis for the month

3) Calculate

- The total energy produced over the month in kWh,
- The value of this energy, assuming 11 cents per kWh, and
- The number of pounds of coal this array offsets over this month (assuming 1.78 lb of coal = 1kWh)

4) How many years will it take for this solar panel array to pay for itself?

- Assume each month is the same (kind of iffy)
- How many months (or years) will it take to generate $11,085?

Wind Energy

5) Load the 4-weeks worth of average wind-speed data from NDAWN. (any town in North Dakota or Minnesota). Plot this in MATLAB as wind speed vs hour.

https://ndawn.ndsu.nodak.edu/

6) Write a function in Matlab where you pass the wind speed at 136m (about 1.8x the wind speed at the ground) and it returns the power generated by a Vestas V136-3.45 MW

Wind Speed (m/s)	0..3	4	5	6	7	8	9	10	11	12	13+
kW	0	25	238	525	947	1,369	1,901	2,445	2,923	3,260	3,450

https://nozebra.ipapercms.dk/Vestas/Communication/4mw-platform-brochure/?page=1

6a) Determine a function in Matlab to approximate this curve.

6b) Use this function to compute how much power a Vestas V136-3.45MW wind turbine would produce from the wind data your found in problem 5.

7) Calculate

- The total energy produced over the month in kWh,
- The value of this energy, assuming 11 cents per kWh, and
- The number of pounds of coal this array offsets over this month (assuming 1.78 lb of coal = 1kWh)

8) Assume this wind turbine costs $4.48 million to build ($1300 / kW). How long will it take for this wind turbine to pay for itself?

https://nozebra.ipapercms.dk/Vestas/Communication/4mw-platform-brochure/?page=1