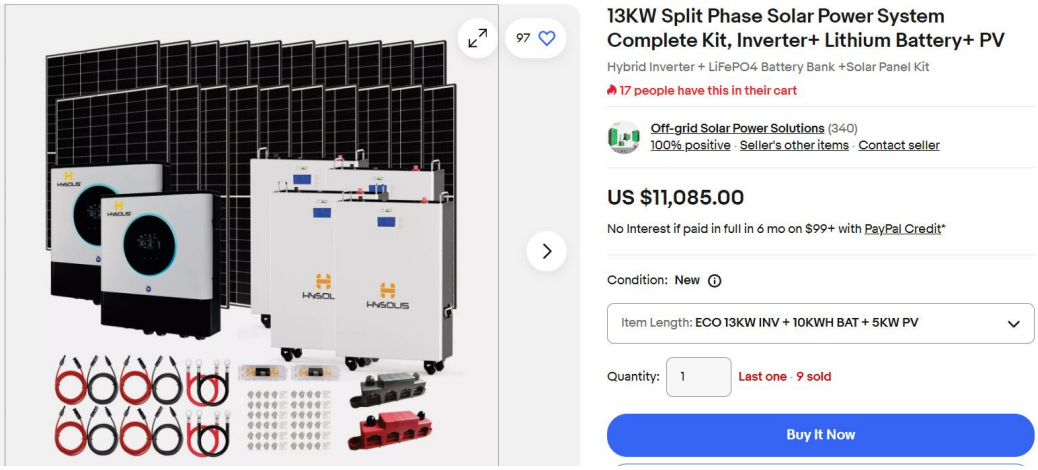
ECE 111 - Homework #5:

Renewable Energy
Due Monday, September 30th

Solar Energy

A 13kW split phase solar power system with a 20kWh battery sells on ebay for $11,085 (October 14, 2024). 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/m2)

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 Excel Energy's time-of-day metering and net-metering:
  - $0.15340 / kWh from 9am to 9pm
  - $0.02559 / kWh otherwise
- 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 $18,905?

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) It takes 1.78 pounds of North Dakota lignite coal to produce 1kWh of electricity. How many pounds of coal does this wind turbine offset over 4 weeks?

8) Assume

- This wind turbine costs $4.48 million to build ($1300 / kW), and
- The value of this energy, assuming Excel Energy's time-of-day metering and net-metering:
  - $0.15340 / kWh from 9am to 9pm
  - $0.02559 / kWh otherwise

How long will it take for this wind turbine to pay for itself?

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