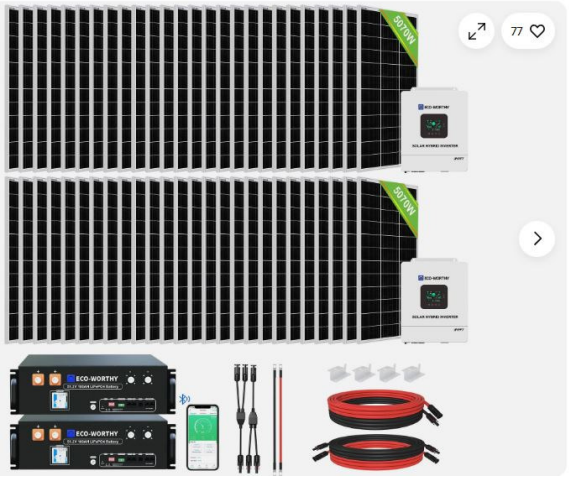
ECE 111 - Make-Up Homework #5:

Renewable Energy - Due Friday, December 12th.

Solar Energy

A 10kW split phase solar power system with a 10kWh battery sells on ebay for $6.999.90 (September 30, 2025). Assuming $0 in tax credits, is this a good buy?



ECO-WORTHY 5KW 10KW 15KW Solar System + 10-15Kwh Storage+ Split Phase Inverter

eco-worthy-us (17030)
98.7% positive · Seller's other items · Contact seller

US $6,999.99

as low as $211.24/mo with Klarna. Learn more

Condition: New

WATTS: 10KW Photovoltaic+10KWH Battery

Quantity: 1 10 available · 21 sold

Buy It Now

Add to cart

Add to Watchlist

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 energy generated in kWh over these 28 days for the array

- 54 panels
- Each panel has an area of 0.89 square meters
- Panel efficiency = 21.5%

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 $6,999?

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 126m (about 1.8x the wind speed at the ground) and it returns the power generated by a Vestas V163-4.5MW MW

Wind Speed (m/s)	0..3	4	5	6	7	8	9	10	11	12	13+
kW	0	33	311	685	1,235	1,786	2,479	3,189	3,813	4,253	4,500

https://www.vestas.com/content/dam/vestas-com/global/en/brochures/onshore/4MW_Platform_Brochure_.pdf.coredownload.inline.pdf

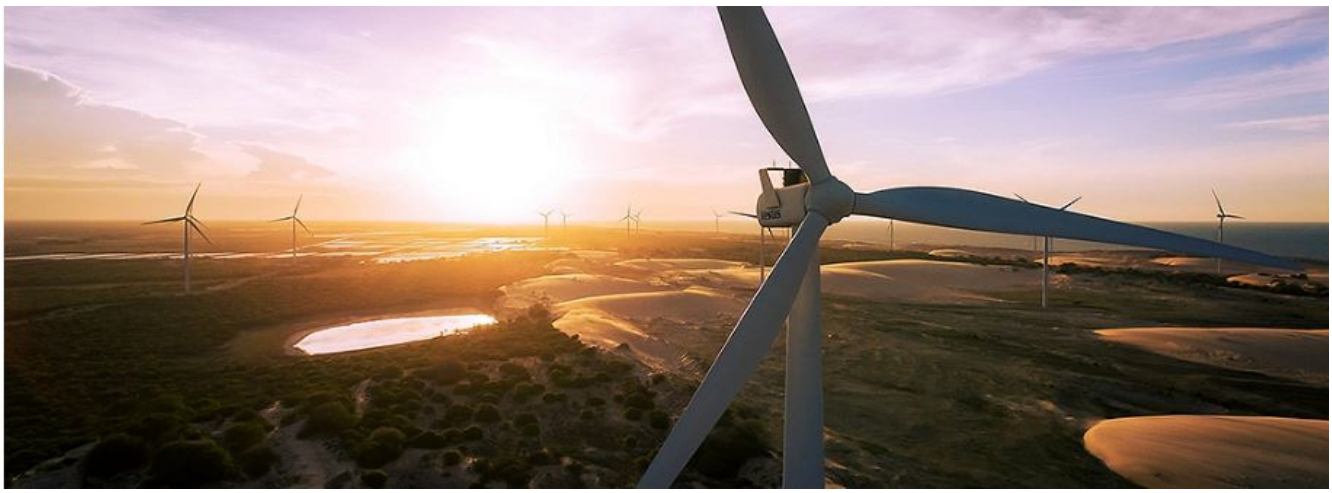
6a) Determine a function in Matlab to approximate this curve.

6b) Use this function to compute how much power this 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 $5.85 million to build ($1300 / kW). How long will it take for this wind turbine to pay for itself?



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