

ECE 111 - Homework #5:

Renewable Energy

Solar Energy

A 7080W solar power system with a 32kWh battery sells on ebay for \$8,399.99 (August 11, 2026). Assuming \$0 in tax credits, is this a good buy?

ECO-WORTHY **FINAL PRICE \$7900**

ECO-WORTHY 7080W Solar Panel +10KW 48Vdc-120V/240Vac Inverter+32kWh Battery

ECO-WORTHY Official Store (22929)
99.5% positive · Seller's other items · Message

US \$8,399.99 or Best Offer
~~\$7,899.99~~ with coupon code [Price details](#)
as low as \$403.27/mo with **Klarna**. [Learn more](#)

Condition: **New** ⓘ
Quantity: More than 10 available · 44 sold

20% off with code **BRANDS20**
Ends 16 Aug · Max \$500.00 [See details](#)

Buy It Now
[Add to cart](#)

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 radiation vs. hour in Matlab

2) Calculate the energy generated in kWh over these 28 days for the array

- 12 panels
- Each panel has an area of 2.58 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 \$8,399?

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 199m (about 2.1x the wind speed at the ground) and it returns the power generated by a Vestas V172-7.2MW

Wind Speed (m/s)	0..3	4	5	6	7	8	9	10	11	12	13+
kW	0	260	654	1,180	1,788	2,485	3,709	4,888	5,645	6,622	7,200

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

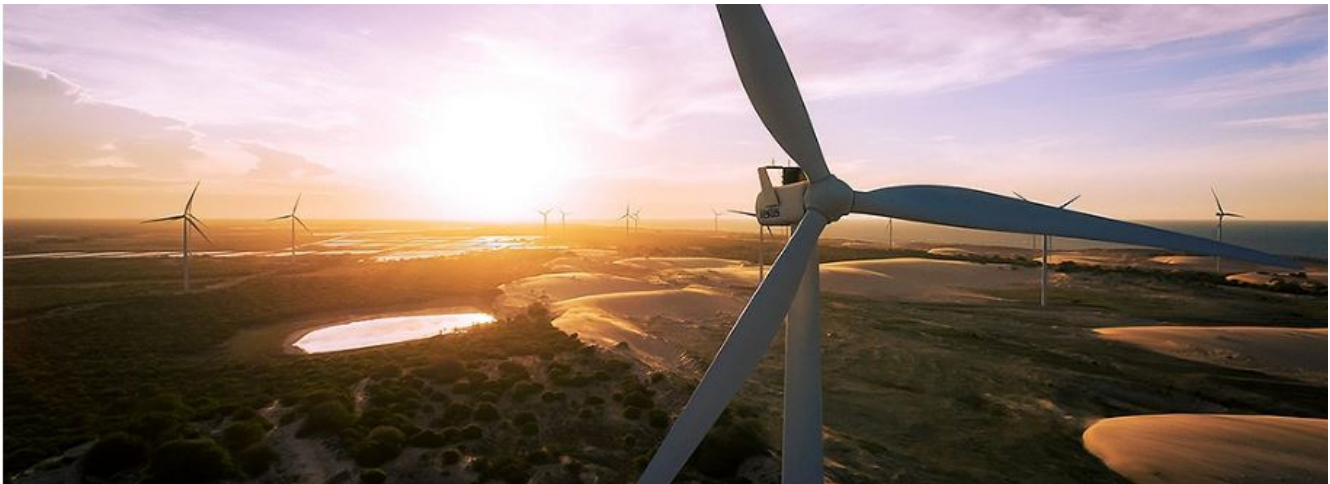
6a) Determine a function in Matlab to approximate this curve.

6b) Use this function to compute how much power this wind turbine would produce from the wind data you 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 \$9.36 million to build (\$1300 / kW). How long will it take for this wind turbine to pay for itself?



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