ENVIRON/ENERGY 590.05 - Economics of Modern Power Systems
Fall 2021

Instructor	**TA**
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Assignment #1
Due date: 09/28/2021

Imagine you work for a consulting company in NC. You were hired by a residential customer to make an investment analysis for rooftop PV installation for his house. The customer provided you with the following information:

(a) Location (research triangle area - RDU, Street: Darling St, zipcode: 27613)

(b) House description (3500 sq. ft., 2 story, 4 occupants, built in 2008)

(c) The desired PV system description. you may use other specs just make sure you state any changes.

- Desired Installed Capacity: 7.92 kW DC (you may suggest more or less capacity)

- 24 modules of REC Solar REC330PEM 72 BLK Panels

- 1 Inverter from SolarEdge 7000H

(d) Utility: Duke Energy Progress

(e) He will finance the whole investment, no downpayment.

Your job is to find out if this is a good investment for the homeowner. And as a good consultant you will provide the customer a detailed report of expected electricity generation from the PV system (monthly and yearly basis), cash flow analysis, payback, LCOE of this alternative, monthly loan amount, etc.

Please don't send a report with a yes or no answer because they will never hire you or your company again!

You may even suggest changes in the system description provided if necessary. What happens with LCOE and monthly payments if he adds/drops 2 or more modules. Remember that if you change the number of modules you might need to change the inverter as well (Hint: remember the DC to AC ratio and look at the Paco and Pdco column to see if inverter capacity supports installed capacity from the PV).

You will follow the steps described on Module 4 to complete the assignment:

1. Estimating System Production

   For this step you may use NREL's System Advisor Model (SAM). Please visit the website (https://sam.nrel.gov) for download and more information about the model. With SAM you can download the National Solar Radiation Database and select the weather data based on the location provided. Specify the Module, Inverter and System design with the provided information. If you are not sure about specific fields, use SAM's default numbers. But state those assumptions in your report. For the yearly load, specify the house information on the electric load menu (choose calculate load date) and use SAM's estimated consumption. The estimated production will appear in the Summary tab after you simulate SAM.

2. Assessing System Cost

   SAM already has information on the cost of the panels and inverter of the PV systems. So you can easily compute the total cost.

3. Forecasting the Value of Electricity

   Based on Duke Energy Progress current and past rates, what is your assumption on electricity rate escalation? Typical solar projects assumes 0.5 to 3% increase per year.

4. Understanding Incentives

   For this part you need to search on the Internet for residential incentives for PV installation in NC. Homeowners qualify for 30% off total investment as federal ITC. Here in NC Duke is also offering an incentive. Find out how much is it. It is very important to tell your client that these incentives have expiration date, so provide him with a time line for each incentive. Aside from the incentives, you may mention on your report that homeowners with PV system can benefit from RECs and that might give him some room to negotiate the price with system developers.

5. Conducting a Financial Analysis

SAM will provide you with cash flow analysis after the simulation. Try to incorporate that in your report in a easy and understandable way. Explain what will be his/her monthly payments, payback time, and other information you may find relevant. Report the Levelized Cost of Energy for this PV system alternative and compare to the LCOE of other resources. You may use SAM's results for the LCOE but make sure you understand them. Create a table where the rows corresponds to 25 years (lifetime of the project), and you will have the following columns:

- Estimated electricity bill with the PVs (if any). Remember to check production and consumption on a yearly basis since you can roll over net excess generation from one month to the other within a year cycle.

- Estimated electricity bill without the PVs

- Electric saving which will be the difference of the first two columns

- Incentive & Rebates (you only have entries in the first year)

- Loan Payment

- Annual Savings (Electric Savings + Loan Payment)

- Cumulative Cash Flow (previous year saving + current year savings)

We talked about how to simulate such a project using SAM on M4. But if you know another model and you want to use it instead of SAM, that's totally fine. Or if you do not want to use SAM, and want to build your own model, it's ok too. But you still might need a software to compute energy production based on solar radiation data for that particular location. Have fun!