EECE325 Fundamentals of Energy Systems Dr. Charles Kim Spring 2022

Homework 7 - PV System Design (100 points)

1. Grid-Connected PV System Design [50 points]

Design a grid-connected south-facing PV system for your parents' house in Oklahoma City, OK which consumes 2000 kWh/yr on 120V. Due to the slope of the roof, the tilt angle of PV has to be equal to <u>latitude minus 15°</u>. (a) What should be the AC rated power of PV/Inverter system, Pac? (b) If inverter efficiency (η_{DC-AC}) is 92%, what should be the DC, STC

rated power of PV module, Pdc?

(c) If the PV modules are 13% efficient $(\eta_{\text{PV}})\,,$ how much area of PVs would be required?

(d) If the installed system cost is 6 per DC STC 1[W], what is the total cost of the system?

(e) Suppose the system cost is paid for with a 6%, 30-year loan, what would be the energy cost of PV electricity [\$/kWh] if there is a renewable energy credit that will pay the owner 0.05[\$/kWh] generated for the entire life cycle?

2. Stand-Alone PV System [50 points]

Design a stand-alone south-facing PV system to deliver your parents' house in Oklahoma City, OK 2000 kWh/yr on 120V AC. The slope of the roof is low but, with added light-weight support structure, the tilt angle of PV is newly raised to latitude.

(a) What is the daily energy need on AC [kWh/day]?

(b) If inverter efficiency (η_{DC-AC}) is 92%, what should be the daily energy need on DC $[kWh/day]\,?$

(c) If the design goal is to provide needed electricity 95% of the time, how many days of usable battery storage would you need?

(d) Continuing question (c) above, what is the usable battery capacity [Ah]? And what should be the nominal capacity of the battery [Ah] (with MDOD=0.8, and T_DR = 0.95)?

(e) When the PV/Inverter/battery system voltage is set at 48 [V], suppose you use Concorde PVX 1080 batteries, how many batteries in series and how many in parallel would you recommend. At \$160 each, how much would the batteries cost?