Exercise Series 1

Exercise 1: LCOE for a modern roof-top solar system

Consider you are buying new solar modules for roof-top mounting and (partial) self-consumption. The modules that you consider are 260€, measure 1.7 m^2, and deliver 350 W_p. Your roof is pointed south, in Switzerland, and you can assume 1200h full sun equivalent per year. A 12 kW inverter is 1369€ and a 20 kW inverter is 1529€. Both have an efficiency of 97%.

a) Calculate how many modules you would need, how much the full system would cost, and how much power would be generated per year for both a 12 kW_p system and a 20 kW_p system.

b) Assume you save 20€cts per kWh that you don't purchase from the grid (it is unrealistic to 100% self consume, but calculating for grid buy-back or battery storage is complex). How many years would it take to repay the total initial cost of each system?

c) Assume roughly 50€ per year in cleaning and maintenance costs, and 0.4% yearly loss in power output. What is the LCOE for each system, assuming a 25 year lifetime?

Exercise 2:

a) Explain the behaviour of the thin film market share during the years. Why do silicon-based PV modules (i.e. made of Si wafers) currently rule the market (over thin films)?

b) What is the main technology used for aerospace applications? What are the main differences in optimization strategies with respect to terrestrial solar cells?

c) Assuming a transition towards electricity replacing all fossil fuel, with an averaged improved efficiency by a factor 3, and assuming we keep our primary energy needs constant at 166'000 TWh per year. How many W of solar panels placed in the desert would you need ? (yield of 1800 kWh/kW) How many W of offshore wind turbine ? (yield of 3500 kWh/kW) How many Small nuclear reactor of 100 MW ? (assuming 90% operational time).