Solar PV

Physics and Mathematics of Sustainable Energy

College of the Atlantic.

1. You have a fan that draws 100W when on at full speed. If the fan was on full speed for an entire year, how much energy would it use?
2. The Westbrook Energy Center Power Plant produces electricity from natural gas.
   (a) Westbrook has a maximum power of 564 MW. If it operated at this power for an entire year, how much energy would it generate?
   (b) In 2020, Westbrook generated $1,011,029$ MWh of electricity. What fraction of the maximum possible energy did Westbrook generate in 2020?
   (c) What is the average power generated by Westbrook in 2020?
3. The Sequoyah nuclear power plant in Soddy Daisy, TN, USA, has a nameplate capacity of 2,441 MW. In 2020 it generated 19,099,189 MWh. What is its capacity factor?
4. The average insolation in Bar Harbor, ME, is 4.29 kWh/day/m^2. Convert this to W/m^2.
5. The solar intensity in Portland, OR, is around 160 W/m^2. Convert this to kWh/day/m^2.
6. The solar intensity in Hancock County, Maine is around 160 W/m^2. Convert this to kWh/day/m^2.
7. A typical new house in the US might have around 50 m^2 of rooftop on which solar panels can be installed. The average monthly electricity consumption for a US home is around 900 kWh/month.
   (a) How much electrical energy would be generated by these solar panels in a month? In a year?
   (b) How much would a year's worth of this electricity be worth in Maine?
   (c) How does this amount of electricity compare to the electricity used in the home?
   (d) How does this compare to the total amount energy used in the US per person per year?
   (e) If this electricity displaced electricity that was generated with a carbon intensity of 450 g of CO_2, how much less CO_2 would be emitted as a result? Is this a little or a lot?
8. Suppose we want to generate 50 kWh of electricity per day from solar for each person in the U.S.
   (a) How much area is required per person? Assume that we have solar farms that get 10W/m^2.
   (b) How much land would it take to do this for every person in the U.S?
   (c) How big an area is this? (What size square has this area?)