

Solar PV

Physics and Mathematics of Sustainable Energy

College of the Atlantic. October 16, 2023

1. The average insolation in Bar Harbor, ME, is 4.29 kWh/day/m^2 . Convert this to W/m^2 .
2. The solar intensity in Portland, OR, is around 160 W/m^2 . Convert this to kWh/day/m^2 .
3. The solar intensity in Hancock County, Maine is around 160 W/m^2 . Convert this to kWh/day/m^2 .
4. 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?
5. Suppose we want to generate 50 kWh of electricity per day¹ 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 10 W/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?)

¹The total energy consumption (not just electricity) of the US is 250 kWh/p/day .