

Energia Solar Fotovoltaica

Problem Sheet 1

(Ver. 2: 2015.10.01)

1. Charging a mobile phone with small PV panel

Consider a small PV module to charge your mobile phone. The PV module has an active area of about 50cm^2 and an efficiency of 15%.

1. Check on your own mobile phone how much energy does it store.
2. Determine how many hours of peak power (1000 W/m^2) does it take to fill it up.
3. If you took the phone (and the PV charger!) to a location where the average annual insolation is about $1900\text{ kWh/m}^2/\text{year}$, determine how often you could call home.

2. Self-demand in Portugal

Consider the *Lei do autoconsumo* in Portugal.

1. How much would a 200Wp PV system produce in Portugal? [average insolation: 1.5kWh/Wp/year]
2. Determine the maximum savings from such a PV system [lifetime: 30 years; price of grid electricity 15c€/kWh with 2% annual increment].
3. Assuming typical installation costs [$2€/\text{Wp}$], determine the payback time.
4. Discuss the costs and benefits of larger PV systems within this framework.

3. PV car

Internal combustion engines are not very efficient in producing electricity for car gadgets such as lights, radio, etc.

1. What is the cost of 1kWh produced from gasoline? [assume: $1.5€/\text{litre}$; $10\text{kWh}/\text{litre}$; 25% mechanical efficiency; 70% electric efficiency]
2. Compare this value with the cost of 1kWh from PV. [assume: $5€/\text{Wp}$; 7 years lifetime; in Portugal, i.e. $1.5\text{kWh}/\text{Wp}/\text{year}$]
3. Assuming that a car requires 300W of electric power, calculate the average savings per 100km. [assume: $20,000\text{km}/\text{year}$, 7 years, average speed $50\text{km}/\text{h}$]

4. Module efficiency

Considering that the BOS & installation cost of a PV system with an efficiency of 15% is of the order 200 €/m^2 determine:

1. The total cost of the PV system per unit area, assuming that the module costs 1 €/Wp .
2. Imagine a new low cost module technology with a cost per unit area of the order of the price of glass (20 €/m^2). What is the minimum efficiency for the new module in order to have a competitive cost?

5. Land for energy

How much land would Portugal need to supply all its electricity needs with PV? [assume: demand: $50\text{TWh}/\text{year}$; $1.5\text{kWh}/\text{Wp}/\text{year}$; 15% efficiency].