

Task 4 (designed by Vassiliki Spiliotopoulou and Andreas Thanopoulos)

Mathematical topic: Measurement, trigonometry

Scientific topic: Electricity

Grades: Upper Middle School and High School

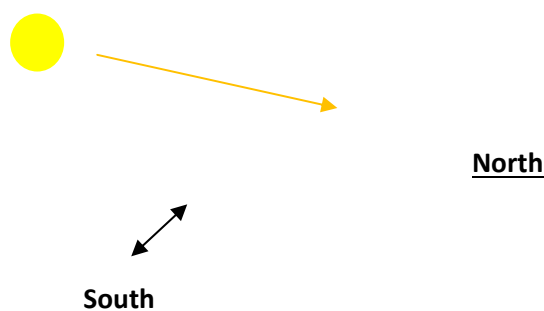
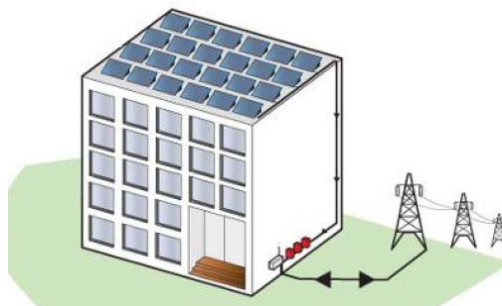
Connection of Mathematics with the workplace of Social Scientists

Issue: Installation of solar cells

Decision making: Is the investment on a Photovoltaic house system worth value?

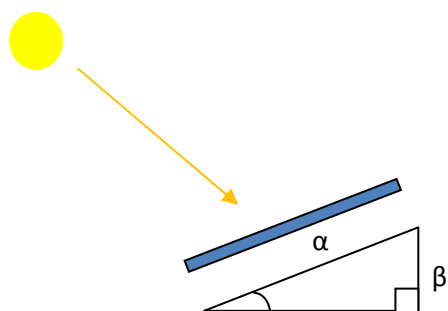
Imagine that your family plans to install solar panels at the flat rooftop of your house in order to become an energy sustainable building. How could you help them to become familiar with the idea of sustainable forms of energy and their practical value? Let's see the installation procedure of a photovoltaic system on the roof of a house with tiles.

[\[http://www.youtube.com/watch?v=SPGY9eqSvR0\]](http://www.youtube.com/watch?v=SPGY9eqSvR0)



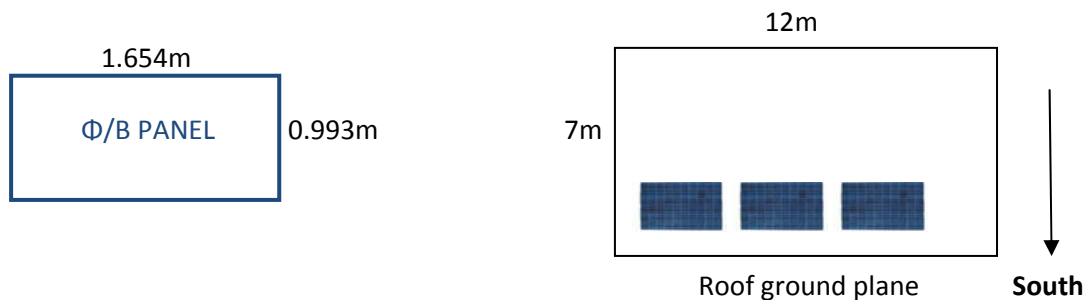
The solar panels will be placed in horizontal rows one next to each other. Each row usually has a distance 0,5m from the others, in order to create enough space for the technician to be able to repair the system in case of damage or break down.

For maximum efficacy in the production of electric current the panels should have south exposure, while their inclination angle is suggested to be 28° from the horizontal. According to existed regulations, the panels should be 1m far from the perimeter line for safety reasons.



γ
 side $\alpha=0.993\text{m}$
 angle $\alpha^\wedge\gamma=28^\circ$

One usual size of solar panel has dimensions 1.645m x 0.993m, while the dimensions of your house flat roof are 12m x 7m.



Could you help your family understand how the solar panels work and persuade for their value in terms of environmental issues? Could you help them in deciding if such an investment is worth value?

Think...

- You could calculate how many solar panels can be placed on the roof of your house, taking into account the information given above.
- You could, also, calculate the profit in Euros for your family, if under the present agreement with the Company of Electricity, the deal is for 0.23875 €/kWh. For this action you would need to find first how high will be the maximum produced power, if you are given that each Φ/B panel produces maximum power 250 Watt. Also, you would need to calculate the yearly production of the photovoltaic system, if the Φ/B solar panels have efficiency 15.2%.

Can you use your school science and mathematics to provide possible solutions and help your family become aware of the issues involved?

You may also need to obtain information from your technician for the cost and the duration of installation of this house photovoltaic system.

In Table 1 you can find useful information, concerning the average produced Solar Energy in Kwh/m² per each month and per year. You will need it.

TABLE 1: Monthly Solar Energy for the best inclination angles β of Φ/B panels (kWh/m² .mo), and best inclination on a yearly (Y) basis, winter (W) and summer (S) period, for the region of Patras*.

Inclination (in degrees)	J	F	M	A	M	J	J	A	S	O	N	D	Y	W	S
7-14	66	82	134	151	200	212	216	201	163	121	79	66	1692	578	1144

23-33	83	96	145	150	189	195	201	196	172	140	100	86	1753	660	1102
42-52	91	100	145	141	170	173	180	181	168	146	109	96	1699	682	1013

*Patras is a town in the south-west of Greece