CWC activity #6 Solar roofs

There are incentives in many countries now to install solar roofs in order to reduce our dependence on fossil fuel generated electricity. The other advantage of such roofs is that locally generated electricity overcomes transmission and distribution losses associated with centrally generated electricity.

Roofs are the most suitable place to install solar cell modules, which are usually 2 x 1 meter in size, because they are less likely to be in the shadow of other buildings or trees.

For the UK, the orientation is in an arc from southeast to southwest and the optimum inclination angle is from 20 to 35 degrees. Outside these limits, it is unlikely that the solar roofs will be cost effective; that is, produce enough sufficient electricity to provide a payback time of 10 years. It is also possible to use flat roofs provided that these have the correct orientation as a frame can be made to incline the panels at the optimum angle.

Aim

The objective of this activity is to examine the buildings at your school and to evaluate the potential for the generation of solar electricity from roof mounted panels.

Tasks

Working in small groups, walk around the outside of each building and complete the attached worksheet.

- identify which roofs are orientated from southeast to southwest
- check the roofs are free from shadow
- record orientation and measure the inclination angle
- measure the length and width of each roof
- calculate the available roof area and determine number of modules of size 2 x 1 m that can be fitted
- from the attached look-up table, determine the annual electrical output for each roof

Notes for teachers

To prepare for this lesson, the process of energy conversion from sunlight to electricity should be explained. The process for identifying suitable roofs is similar for all buildings including school buildings and student's homes.

Suitable computer programs such as PVSyst, allow not only the calculation of the monthly output but also the average installation cost. Together with knowledge of any feed-in tariff or grant, this would enable students to calculate the payback time.

If time is available ask each group to make a poster illustrating their findings and recommendations; this could be shown to other classes and the head teacher.

Materials:plan of building(s) (if possible)**,** compass**,** inclinometer,worksheets, camera (optional)

Key words: buildings, solar roofs, solar cells

Skills: observation, innovative and creative thinking

National curriculum subjects:physics, geography

Age range: 11 – 18 key stage 3 – 6

Worksheet

Name of building:				
Shadows by trees	☐	yes	☐	no
Shadows by other buildings	☐	yes	☐	no
Roof type	☐	inclined	☐	flat
For each roof orientated from southeast to southwest, observe and measure • orientation(degrees) • inclination (degrees, φ) • length (m) • width (m) Calculate roof area from formula length x width/cosφ where φ is the inclination angle Number of 2 x 1 m cells that can be fitted Total area of solar cells				
From look-up table given, record the potential annual electrical output kWh (e)				

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Shadows by trees	☐	yes	☐	no
Shadows by other buildings	☐	yes	☐	no
Roof type	☐	inclined	☐	flat
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For each roof orientated from southeast to southwest, observe and measure

- orientation(degrees)
- inclination (degrees, φ)
- length (m)
- width (m)

Calculate roof area from formula length x width/cosφ where φ is the inclination angle

Number of 2 x 1 m cells that can be fitted Total area of solar cells

From look-up table given, record the potential annual electrical output

kWh (e)

Annual output look-up table (for area of 10m^2, ventilated, polycrystalline cells)

orientation	inclination (degrees)	annual output (kWh)
southeast	20	858
	25	862
	30	862
	35	858
south	20	886
	25	894
	30	898
	35	898
southwest	20	859
	25	863
	30	863
	35	860