Estimating the potential deployment, costs and income for a community-wide solar PV scheme

In this exercise attendees will examine large-scale satellite photos of your neighbourhood, village or town. They will be assessing what the total solar resource might be if all the suitable roof space could be used.

Allow **50-60 minutes** to complete this exercise

Films that accompany this exercise

- Solar power: an introduction (disc 1)
- Things to consider before starting a solar project (disc 2)
- West Oxford Case Study (disc 1)

Number of people or groups

One person can manage to run this exercise alone, but if you have extra help, then extra facilitators can float between groups. We suggest a minimum of two and a maximum of six people per group.

Materials needed

1) Large-scale satellite photos of your area

These need to be at a scale which enables you to identify individual buildings, and you can get them from Google Earth or Google Maps. You need enough print-outs to cover your whole village or neighbourhood which probably means several sheets of A3 stuck together to make one large composite image. On it, clearly mark the points of the compass, including the intermediate points (e.g. SW, SE)

If you have a small or compact village and fewer than 15 people at your meeting, you might find that one large map is sufficient. For larger communities, use blown up maps of different sections of the village or neighbourhood, and split into groups to assess a section each.

2) Felt-tip pens, pencils or crayons

You will need different colours – red, green, black and blue – and one of each colour for every group. If you print your photos in colour, you may want to use sticky dots instead, because pens can be hard to see on colour photos. Sticky dots are quite big so this will mean you need to print your photos at a slightly larger scale.

3) Tracing paper (optional)

Use this to mark up an overlay map of the satellite photos, as this could help people not used to looking at aerial views to quickly work out where they are. Alternatively, you could mark key buildings such as shops, schools, libraries on the photos.

*4) A large print-out of **table 1** below*

You could print this out very large, or simply copy it onto a sheet of flipchart paper. It needs to be big enough for everyone to read. The red boxes show where you will fill in data during the course of this exercise.

5) A calculator and several large sheets of paper – ideally flipchart paper

Arranging the room

Stick the satellite photos up on the walls around the room before the event starts. Hide them by hanging sheets of flipchart paper over them until it's time to start the exercise. Each sheet of flipchart paper should have the following list written on it:

Number of dwellings [green] =
Number of commercial properties [red] =
Number of public buildings [blue] =

Running the exercise

Stage 1) Grouping and explaining (10 minutes)

Explain to everyone that you are going to assess all the likely places for solar panels in your community, and that you'll do this in groups – one group for each of the satellite images you have. Ask people to divide into groups of roughly equal size.

Ask each group to stand in front of one of the satellite photos, and for a member of each group to reveal the image by removing the large sheet with the list written on it, and sticking it on the wall nearby.

Tell them that they are going to count the number of buildings that have a roof that faces south, south-east or south-west (since solar PV is most efficient in this range). Tell them to include all flat roofs since these allow solar panels to be mounted on frames oriented south.

Explain that they will now mark each roof with a different colour:

- **green** for a house (use local knowledge to work out whether houses are semi-detached etc)
- **red** for a shop or other commercial building
- **blue** for a public building, like a church or community centre.

Once they have made all the marks, they are to look more closely at them and put a black cross on them if they think they will be significantly shaded for much of the day, e.g. by a large tree or a tall building.

When they have done all this, they should add up all the green, red and blue dots that have **not** been crossed out and write up the three totals on the pre-prepared Table 1.

Stage 2) Carrying out the exercise (15 to 25 minutes)

While the groups are working, circulate the room to give support and answer any questions they may have.

Stage 3) Calculating the total potential solar resource (10 minutes)

Once everyone has finished, invite them to sit down again and tell them that you will do some quick calculations based on the resource they have identified (i.e. the numbers of dwellings, commercial properties and public buildings from all groups). Tot up the figures and write them in the appropriate boxes on your large version of **table 1** for everyone to see. What you end up with should look like the example in **table 2** (below).

Explain to the group that each kilowatt (kW) of installed PV capacity will produce around 800 kilowatt-hours (kWh) per year. So (for, the example shown in table 2) once you've done some quick calculations, you could show that the amount of electricity that could be produced is 459,200 kWh per year, roughly that used by 112 average English homes over a year. You could also go on to show that this would prevent the emission of almost 5,000 tonnes of CO_2 being emitted to the atmosphere over the 25-year lifetime of the solar panels.

Stage 4) Potential costs and income, and discussion (15 minutes)

Here's where you fill in the income and costs. Allow five minutes for the calculations, and a further ten minutes to talk through the results.

Your completed table will look something like **table 3**. *(Tip: it's more meaningful if you talk through the calculations as you do them i.e. "I am multiplying the average cost of a panel by the total number of panels" etc)*

You might now want to take suggestions about what your community might do with this very basic resource assessment. By now it should be clear that while PV is an expensive technology for the amount of electricity it generates, the current level of feed-in tariff means it can represent a good investment in the right circumstances.

Here are some other issues around funding a solar scheme that you may wish to discuss:

- Could you set up a bulk-buy scheme and negotiate discounts for both capital and installation costs?
- Are there grants for which you could apply?
- Are buildings as energy efficient as possible? (There's little point in installing energy-generating technology if less expensive energy-saving options are ignored.)
- Can households who can't afford solar panels be included in the scheme? Maybe by installing panels on the roofs of lower-income householders who get to keep them once the feed-in tariff has paid off the capital and interest costs?
- What other partners could you involve? Your local authority may be very interested in your scheme and have roof-space and funding available.

During this discussion time the facilitator could also re-calculate the income based on different costs e.g. if cost per kW was reduced by 10% due to a bulk buy scheme, how much extra would the community make?

Bringing the event to a close

Tie up the discussion by asking if anyone would be interested in researching the options. Use this as an opportunity to recruit more volunteers. Record all the comments from this discussion as a bulleted list on a flipchart – you can ask a member of the audience to be the recorder if you are running this event alone. You should write up the flipcharts and distribute these as soon as possible after the event.

Table 1

Print this table out very large, or simply copy it onto a sheet of flipchart paper. It needs to be big enough for everyone to read. The red boxes show where you will fill in data during the course of this exercise.

Type of building	Number	Average size of system	Total capacity (kW)
Domestic dwelling		2kW	kW
Office/shop		4kW	kW
Community building		4kW	kW
Total capacity			**kW**

A 1kW solar PV panel will produce around 800 kW hours (kWh) per year, so our community could generate ...	(_____ kW) x (800 hours) = _____ kWh per year of power
The average house uses about 4,100 kW hours of electricity per year **(see note 1 below)**, so we could be producing the equivalent electricity of ...	(_____ kWh per year) ÷ 4,100 = _____ homes
0.43kg of CO_2 is emitted for each kWh of electricity produced by the grid, so producing our own from solar panels would save ...	(_____ kWh) x (0.43kg CO_2) = _____ kg or _____ tonnes of CO_2 per year , which over 25 years, would amount to: _____ tonnes
Feed-in tariff income for panels 4kW peak or less is currently ...	_____ pence per kWh **(see note 2 below)**
Total potential annual generation of electricity (kWh) multiplied by feed-in tariff income ...	(_____ pence) x (_____ kWh) = £_____ annual income for the community
Total potential (kWh) multiplied by generation income over 25 years ...	25 years x £ _____ (annual income) = £_____
Cost per kW installed (assuming all 574kW not installed together, so no economies of scale) ...	= £3,500 **(see note 3 below)**
Total installation cost for all panels ...	£3,500 x (_____ kW) = £ _____
Difference between total installation cost and total income ...	(Total installation cost) minus (total feed-in tariff income) = £ _____ income for the community

Table 2 This is an example of what the top half of table 1 might look like once you have filled in the figures from the exercise in stage 2

Type of building	Number	Average size of system	Total capacity (kW)
Domestic dwelling	257	2kW	514 kW
Office/shop	12	4kW	48 kW
Community building	3	4kW	12 kW
Total capacity			574 **kW**

A 1kW solar PV panel will produce around 800 kW hours (kWh) per year, so our community could generate ...	(574 kW) x (800 hours) = 459,200 **kWh** of power per year
The average house uses about 4,100 kW hours of electricity per year **(see note 1 below)**, so we could be producing the equivalent electricity of ...	(459,200 kWh per year) ÷ 4,100 = 112 homes
0.43kg of CO_2 is emitted for each kWh of electricity produced by the grid, so producing our own from solar panels would save ...	(459,200 kWh) x (0.43kg CO_2) = 197,456 kg or 197 tonnes of CO_2 per year, which over 25 years, amounts to 4,936 tonnes

Table 3 This is an example of what the lower half of table 1 might look like once you have filled in the figures from stage 4 of the exercise

Feed-in tariff income for panels 4kW peak or less is currently ...	21 pence per kWh **(see note 2)**
Total potential annual generation of electricity (kWh) multiplied by feed-in tariff income ...	(21 pence) x (459,200 kWh) = £96,432 annual income for the community
Total potential (kWh) multiplied by generation income over 25 years ...	25 years x £96,432 = £2,410,800
Cost per kW installed (assuming all 574kW not installed together, so no economies of scale) ...	= £3,500 per kWh **(see note 3)**
Total installation cost for all panels ...	£3,500 x (574 kW) = £2,009,000
Difference between total installation cost and total income ...	(Total installation cost) minus (total feed-in tariff income) = £401,800 income in the community

Note 1 This figure is from the Department of Energy and Climate Change (**www.tinyurl.com/4lbnvj3**). The DECC statistics can be broken down by local authority area, so, if required, you can look for the average for your county, district or unitary authority, and use this figure in the calculations.

Note 2 21p per kWh is the proposed feed-in tariff rate for solar PV installations up to 4kW from December 12, 2011. Check the rate in place at the time you are running this exercise at www.energysavingtrust.org.uk.

Note 3 £3,500 per kW of solar capacity installed is a good average cost figure for 2012. These costs may go down further so check www.energysavingtrust.org.uk for updated average costs.