Harnessing the power of the Sun
Could solar farms be used in your area?

Radiant light and heat from the Sun can be harnessed using a range of ever-evolving technologies to produce electrical energy. It is renewable energy. The technology can be divided into active solar or passive solar.
Active solar techniques include the use of photovoltaic systems, concentrated solar power, and solar water heating to harness the energy.
Passive solar techniques include orientating a building towards the Sun, selecting materials with favourable thermal mass or light-dispersing properties, and designing spaces that naturally circulate air.

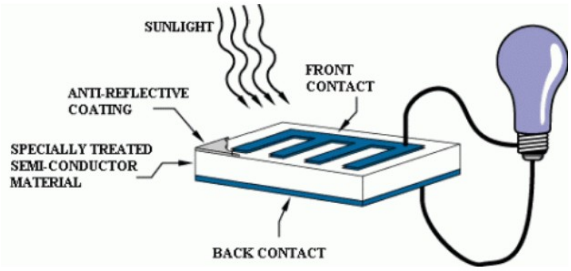
It has been found that the annual potential of solar energy is several times larger than the total world energy consumption is today.

Solar farms are large-scale collections of photovoltaic (PV) panels spread over the land or on buildings. They capture the sun's energy to generate electricity which is then fed into local and regional power grids.

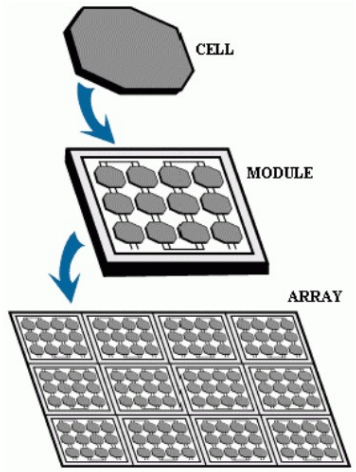
Mingay Farm solar farm, bank of the Great Ouse, near Aldreth, Cambridgeshire, England.
Solar panels are angled to collect the most solar power from the Sun.

A photovoltaic (PV) cell, also known as a solar cell, generates electricity when exposed to photons, or particles of light. This conversion is called the photovoltaic effect, which was discovered in 1839 by French physicist Edmond Becquerel. The underlying physics was formulated by Einstein in 1905, for which he received a Nobel Prize.

Solar cells are made of semiconductor materials, such as silicon, as used in the microelectronics industry. For solar cells, a thin semiconductor wafer is specially treated to form an electric field, positive on one side and negative on the other. When light energy strikes the solar cell, electrons in the atoms of the semiconductor material are given sufficient energy to escape from their orbitals. If electrical conductors are attached to the positive and negative sides, forming an electrical circuit, the electrons can be captured in the form of an electric current. The treatment, or "doping", of the silicon wafers uses rare-earth elements such as gallium, indium and selenium. Current production cells usually have a single semi-conductor layer but more efficient cells with several layers with differing treatments to absorb different wavelengths of light are in development.



Elementary cell



From solar cells to the array

Your local area
Go with your group to a local area where you have a good view of the surrounding region or just look out of the window, or study a view on a screen.

Discuss the following:
Could solar farms be built here, in this area?
List the **advantages** of solar farms.
Possible answers -
- *renewable form of energy,*
- *no carbon emissions when constructed - critics argue that solar farms have a hidden carbon footprint, due to their manufacture and construction. But this "carbon debt", will be paid off over their lifetime as there are no associated emissions. Construction of solar PVs works out to about 50g of CO_2 per kWh compared to coal's 975g of CO_2 per kWh, or about 20x 'cleaner'.*
- *low maintenance,*
- *sheep can graze around the panels,*
- *usable on flat or sloping land,*
- *can be used on marginal land;*
- *can be installed on most roofs.*

List the **disadvantages** of solar farms.
Possible answers -
- *may take up good agricultural land,*
- *vegetation between the panels may be killed off using chemicals,*
- *parts for the panels may come from regions of the world where carbon emissions are not well monitored,*
- *rare earth elements are required in production. There is a world shortage of the supply of these.*
- *not as attractive as green fields.*

What impact might it have on the local community?
- *installation would provide employment;*
- *maintenance would provide employment;*
- *some local residents may object to the appearance.*

If it could happen here, should it happen here?

Back up

Title: Harnessing the power of the Sun

Subtitle: Could solar farms be used in your area?

Topic: Discussion about how solar farms might affect the local area.

Age range of pupils: 14 years upwards

Time needed to complete activity: from 15 minutes to two hours depending on what the potential of the local area is and the levels of discussion.

Pupil learning outcomes: Pupils can:
- explain how solar farms work;
- decide whether solar farms could be built locally;
- explain what effects solar farms might have on local communities.

Context:
Government 'net-zero' targets will affect many areas across the world. This Earthlearningidea explores what the impacts of building solar farms might be in your local area. Other mitigation and adaptation measures are discussed in other Earthlearningideas.

Rare earth elements are found in several areas of the world but most production is currently in China. Most processing is also currently carried out in China. The processes use very toxic and environmentally-damaging chemicals which should be controlled.

There are national security implications in the lack of alternative sources.

Following up the activity:
Evaluate the possibilities for energy sources alternative to fossil fuels using the Earthlearningidea, 'What is/are the least bad option(s) for plugging the future global energy gap?' at
https://www.earthlearningidea.com/PDF/343_Plugging_energy_gap.pdf
for other ideas of what could be developed in your area.

Refer to the Earthlearningidea 'Finding the Earth in the UN Sustainable Development Goals'
https://www.earthlearningidea.com/PDF/319_Sustainable_development.pdf

Underlying principles:
- Energy can be obtained by harnessing the power of the Sun.
- Solar power is renewable and reliable.
- Local potential impacts of solar farms can be explored and evaluated.

Thinking skill development:
Through construction, the potential impact of solar farms can be visualised. Discussing their impact from different perspectives will cause cognitive conflict and explanations will involve metacognition. Applying these ideas to other environments involves bridging.

Resource list:
A view, either from a hill, a window or on a screen

Useful links: Search 'net-zero' on the Earthlearningidea website to find other Earthlearningideas relating to climate change mitigation or adaptation; the list is on page 3.

Use a search engine like Google to explore the internet for more information about likely global impacts of 'net-zero'. You can access a tool to help visualise how climate change might affect your local area at:
https://www.bbc.co.uk/news/resources/idt-d6338d9f-8789-4bc2-b6d7-3691c0e7d138

Source: Elizabeth Devon of the Earthlearningidea Team with thanks to Dr. Simon Waldman, University of Hull for technical advice.

The 'How will the 'net-zero' target affect your local area?' series of Earthlearningideas

Topic			Earthlearningidea title
Introduction			How will the 'net-zero' target affect your local area?
Possible mitigation measures	Use alternative energy sources	Solar	Harnessing the power of the Sun
		Wave	Harnessing the power of waves
		Wind	Farming the wind: through onshore and offshore windfarms
		Tidal	Tidal energy
		Nuclear	Nuclear power - harnessing the energy of the atom
		Nuclear waste	Nuclear waste disposal
		Biofuel	Liquid biofuels: keeping our wheels turning into the future
		'Blue' hydrogen	Blue hydrogen: the fuel of the future?
		Geothermal – hot rocks	Deep geothermal power from 'hot dry rocks': an option in your area?
		Geothermal – flooded mines	A new use for old coal mines
		Hydro – small scale	Small-scale hydroelectric power schemes
		Heat pumps	Heat from the Earth
		Waste – incineration	Energy from burning waste
		Waste – methane	Energy from buried waste
	Stop fuels releasing greenhouse gases	Carbon capture	Capturing carbon?
	Store energy from sources that give irregular energy supplies	Batteries	Nuclear batteries: the future?
		'Green' hydrogen	Green hydrogen used to even out renewable energy supplies?
		Hydro – storage	Matching supply and demand using stored water
		Compressed gas	Storing gas underground: What can we store? How can we do it? How will it help?
	Provide raw materials for new technologies	Electric vehicles	Electric vehicles: the way to go?
		Insulation	How do I choose the best insulation?
	Remove carbon form the atmosphere	Enhanced weathering	Speeding up nature to trap carbon dioxide
		Tree planting	Let's plant some trees
Possible adaptation measures		Coastal flooding	How will rising sea level affect our coastlines?
		Inland flooding	Inland flooding: a Sheffield case study
		Landslides	Landslide danger
		Agriculture	The future for global agriculture