lightsource bp

Solar Teaching Resource 2018

Lightsource BP, advancing solar

SOLAR TEACHING RESOURCE
CONTENTS

Included in this resource pack, you will find:

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UNIT ONE
CLIMATE CHANGE: THE FACTS

Conventional energy generation releases greenhouse gases such as water vapour, carbon dioxide and methane. These gases trap and re-emit infrared radiation, causing the atmosphere to warm up. The rise in global temperature is having detrimental environmental effects across the planet.

Arctic ice melting.

Rising sea levels causing increased flooding in Bangladesh.

Drought in the Sahel region of Africa.

Melting sea ice is endangering polar bears by reducing their habitats.

Deforestation, such as here in Tanzania, reduces the amount of trees which remove carbon from the atmosphere.

Acidification of the oceans and the rise in sea temperature is causing the destruction of coral reefs.

Solar Aid

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UNIT ONE
TEACHING RESOURCE

1. Mind map climate change - Students identify a question they want to know more about and investigate it, reporting back on their findings.

2. Students choose a locality and explore the impacts of climate change there.

   Visit: http://general.esri.akadns.net/mapmuseum/mapbook_gallery/volume20/conservation2.html to look at maps of shrinking forests in the Kilimanjaro region in Tanzania as a starting point.

3. Compare contrasting localities and the impact of increased extreme weather and their ability to cope, e.g. flooding in Bangladesh.

4. Use role play to explore different people's opinions about climate change. Pupils plan and run a climate change campaign. This could be:

   An assembly
   A poster campaign
   An information leaflet for parents
   A draft letter to their local MP, asking what is being done about climate change

UNIT ONE
CLIMATE CHANGE: THE SOLAR SOLUTION

- Solar energy is harnessed from sunlight. The energy from sunlight enables all living things to grow, and makes it possible for us to exist on Earth.
- Solar energy is a “Renewable” source - meaning it will not run out.
- Fossil fuels, such as coal, oil and natural gas, not only release greenhouse gases when they are burnt for energy production, but they are also are finite resources and will run out if we continue to use them at the current rate.

How Solar Photovoltaic (PV) technology works

Solar photovoltaic (PV) panels absorb daylight and convert it into electricity.

Each solar panel is made up of photovoltaic (PV) cells. The cells convert the light energy from daylight into electrical energy. PV cells are made of very thin wafers of silicon, which lie under a protective transparent layer. Daylight from the sun hits a negatively doped silicon layer which ‘excites’ electrons effectively ‘removing’ them from their atoms. This creates a potential difference between the two layers of silicon, which stimulates a flow of electrons. The flow of electrons generates Direct Current (DC) electricity. As there are no moving parts, the process is silent.

The electrical energy travels along cables from the solar components to an inverter. This converts the Direct Current (DC) to Alternating Current (AC) which is suitable for general use. The AC electricity from the inverter passes through an AC isolator switch to the generation meter, which records the amount of electricity generated in kilowatt hours (kWh). The AC electricity is then wired to the local distribution network.

UNIT TWO
CLIMATE CHANGE: THE SOLAR SOLUTION

Components of a Solar Farm

SOLAR MODULES

A solar module converts daylight into electrical energy. It contains several photovoltaic (PV) cells which are typically silicon based.

INVERTERS

The solar modules feed power into inverters, which convert the produced Direct Current (DC) power into Alternating Current (AC) electricity, suitable for transmission into the grid.

IRRADIATION SENSOR

Sensors are used to measure the solar irradiation. The data collected is then compared with the output of the plant in order to monitor its performance.

CABLING

All cabling is weather proofed and securely attached to the structure and buried where appropriate.

Where livestock are present, the framework is at least 800mm from ground level, keeping equipment safely away from grazing animals.

FRAMEWORK

The aluminium framework is secured with galvanised foundations. The structures are quick to erect, very strong and can be removed easily to allow the ground to be fully restored once the plant is decommissioned.

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UNIT TWO
CLIMATE CHANGE: THE SOLAR SOLUTION

Lightsource Case Studies

Luson Farm, Devon, 1.9 MW

The solar farm at Luson Farm was completed in March 2013. It now generates enough clean, renewable energy to power around 575 homes.

During the planning phase, 2 badger setts were identified and the design of the solar farm had to be changed to accommodate them. A 30 metre 'buffer zone' was left around the setts to ensure that their habitats were not disrupted.

Wheal Jane, Cornwall, 1.5 MW

This site in Cornwall occupies a 7.2 acre plot at on a reclaimed mine. The solar farm consists of 6,680 solar panels that together generate 1,427 MWh per year. This electricity feeds into the National Grid to power the equivalent of 432 homes.

The solar farm at Wheal Jane demonstrates how such developments can sustain the balance of our need for clean energy whilst maintaining our landscape.

Yeowood, Somerset, 1.3 MW

Yeowood Solar Farm provides electricity for over 80% of the local area of Congresbury.

The solar farm was installed on an agricultural field which has remained in use as farmland. It currently houses more than 24,000 hens amongst the panels.

The site is also watched over by 2 neighbouring llamas belonging to the landowner!

Trevemper, Cornwall, 1.7 MW

The Trevemper solar plant is located on the south facing slope of a hill to the south of the Gannel Estuary near Newquay. This site consists of over 6000 ground mounted solar panels and was remarkably constructed and commissioned in three weeks.

The site is specifically engineered to accommodate sheep grazing beneath the panels and in the wide grassy avenues between the rows.

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UNIT TWO
CLIMATE CHANGE: THE SOLAR SOLUTION

Advantages of Solar Power

IT IS PREDICTABLE

Solar panels do not need direct sunlight to produce electricity, only daylight. Daylight hours are easy to predict - we can calculate what time the sun will rise and what time it will set on each day of the year for any specific location.

IT IS PASSIVE

The process happens silently, causes no pollution and does not harm wildlife.

IT CAN BE IMPLEMENTED QUICKLY

Unlike nuclear or conventional power plants, which can take years to construct, solar farms can be installed in a matter of weeks or months. This means we can react to the issue of climate change fast.

USEFUL IN REMOTE PLACES

IT WORKS ON A SMALL OR LARGE SCALE

Disadvantages of Solar Power

STORAGE

Solar power can not be generated at night, so the electricity needs to be stored.

COST

At the moment, photovoltaic cells are expensive, though they are becoming cheaper as the industry grows.

RELIANT ON A GOOD AMOUNT OF LIGHT

Solar panels do not work as well in areas which do not receive a lot of sunlight every day.

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UNIT THREE
ENERGY PRODUCTION AND CARBON FOOTPRINTS

Carbon dioxide is one of the primary greenhouses gases and thus contributes significantly to global warming. Solar power generation reduces the UK's reliance on energy production through coal and gas, which is a huge contributor to carbon emissions.

Driving a Ford Mondeo 5km will produce 1kg of CO_2

Driving the Ford Mondeo for one year could result in 4500kg (4.5tonnes) of CO_2

A typical 3 bedroom house in the UK may produce 2 tonnes of CO_2 per year as a result of its electrical energy consumption.

It would take approximately 100 years for a broad leaf tree to offset 1 tonne of CO_2

A 2kWp solar farm in Britain could offset 1 tonne of CO_2 every year.

Measuring Energy: What's Watt...

Electrical power is measured in Watts
1000 Watts of power is a kilowatt (kW)
1000 kilowatts of power is a Megawatt (MW)

Electrical energy is generally measured in kilowatt hours (kWh). A kilowatt hour (kWh) is 1000 Watts per working hour. For example, running an electric fan heater rated at 1000 Watts for one hour would use one kWh of energy.

How much electricity a solar farm will generate depends on its capacity and also the strength of daylight at its location. To give you an idea, the following statistics are based on a system in the south of England with a capacity of 1 MW:

950,000 kWh of electricity per year

300 homes powered

500 tonnes of carbon saved per year

Carbon savings per year equivalent to taking 116 large family cars off the road

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UNIT THREE
TEACHING RESOURCE

Energy and Carbon Footprints

1. Explore the 'Energy Journey' that electricity makes from the coal in the ground to switching on a light:

   http://www.solarschools.net/resources/stuff/how_electricity_is_made.aspx

   http://www.solarschools.net/resources/stuff/power_station_to_us.aspx

   Watch this BBC class clip (10mins) on how electricity is made:

   bbc.in/PzhazD

2. Calculate a carbon footprint

   Students keep an 'Energy Diary' for a day, from waking to going to bed.

   Pupils can then calculate their carbon footprint using this tool:

   www.planet-positive.org/how_2_kidscalc.php

3. Run an energy saving campaign at school and in the local community.

   Visit the 10:10 website for case studies of how some schools are cutting their energy use:

   http://www.1010global.org/uk/education/schools/cut

Energy Around the World

1. DISCUSSION: What would life be like without electricity?

   What if we had no power for a week?
   What about a month?
   Students complete a flow diagram of consequences

2. DISCUSSION: Over 1.5 billion people in the world have no access to electricity

   Investigate what sources of light are used around the world. Watch this BBC Class Clip (1 min) introducing light sources used in rural Zambia:

   http://www.bbc.co.uk/programmes/p0119kh6

3. Use SolarAid's Lighter Learning teaching to explore the impact of using kerosene (paraffin) for lighting:

   http://solar-aid.org/lighterlearning/

4. What is the impact of solar around the world? Use SolarAid's case studies to explore how solar has improved children's lives:

   http://old.solar-aid.org/sunnyschools/blog/resources.html?url=/sunnyschools/blog/resources.html

UNIT FOUR
USING THE DATA SHEETS

The Lightsource online portal offers students a chance to see data from real solar farms in action. Using the portal presents a brilliant opportunity to learn about the reality of the world of renewable energy production.

TASK: Log in to the portal to take readings of the electricity generated by an operating Lightsource solar farm, and turn the data into graphs.

1. Using **Solar Sheet 1**, take hourly measurements of how much electricity the solar farm is producing.

2. Use **Solar Sheet 2** to monitor the weather simultaneously and analyse the effect on the amount of electricity generated.

3. Once you have completed all of the data fields, use **Solar Sheet 3** to plot a graph with days of the week on the X axis and kWh on the Y axis, as shown in Figure 1.

4. Use the weather data and the graph produced to determine to what extent the seasons will affect the energy generated.

5. Highlight any outliers and compare them to the weather journal to try to explain them.

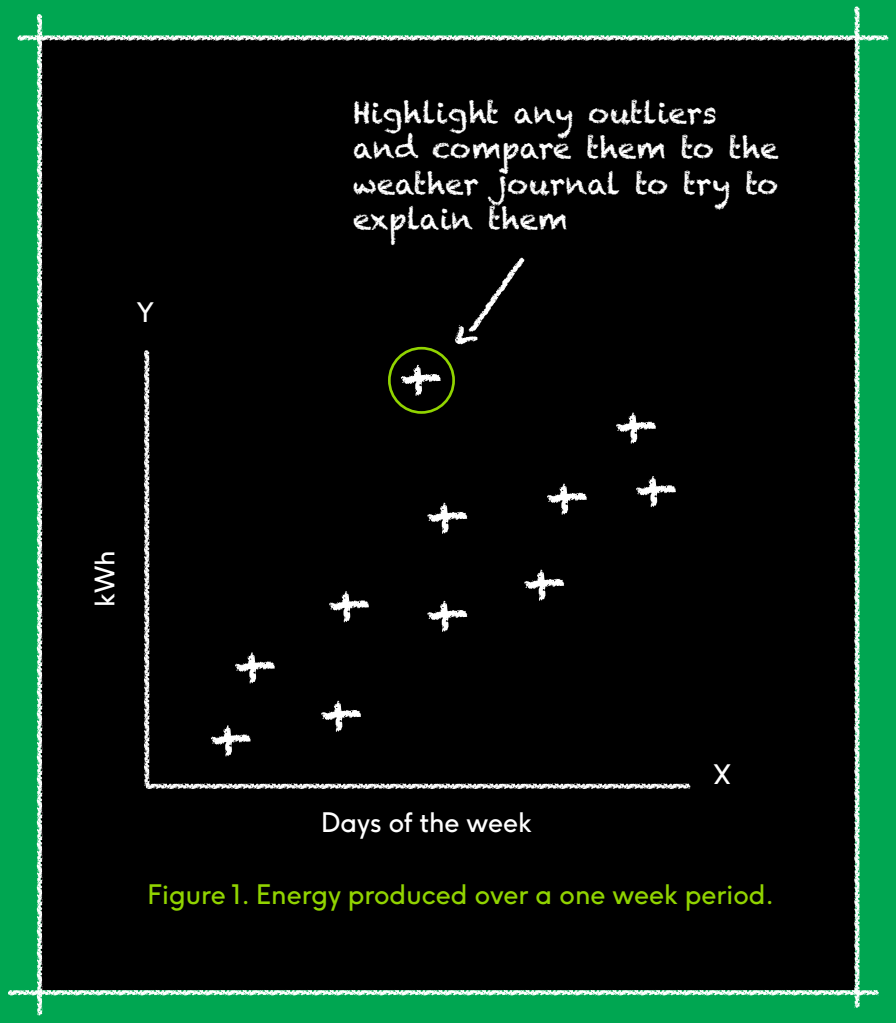


Figure 1. Energy produced over a one week period.

UNIT FOUR
USING THE DATA SHEETS

Solar Sheet 1: Data Collection

Record the hourly meter readings in the table below to track how much energy the solar farm is producing.

Use your maths skills to calculate the total amount of electricity produced each day between 7am and 6pm.

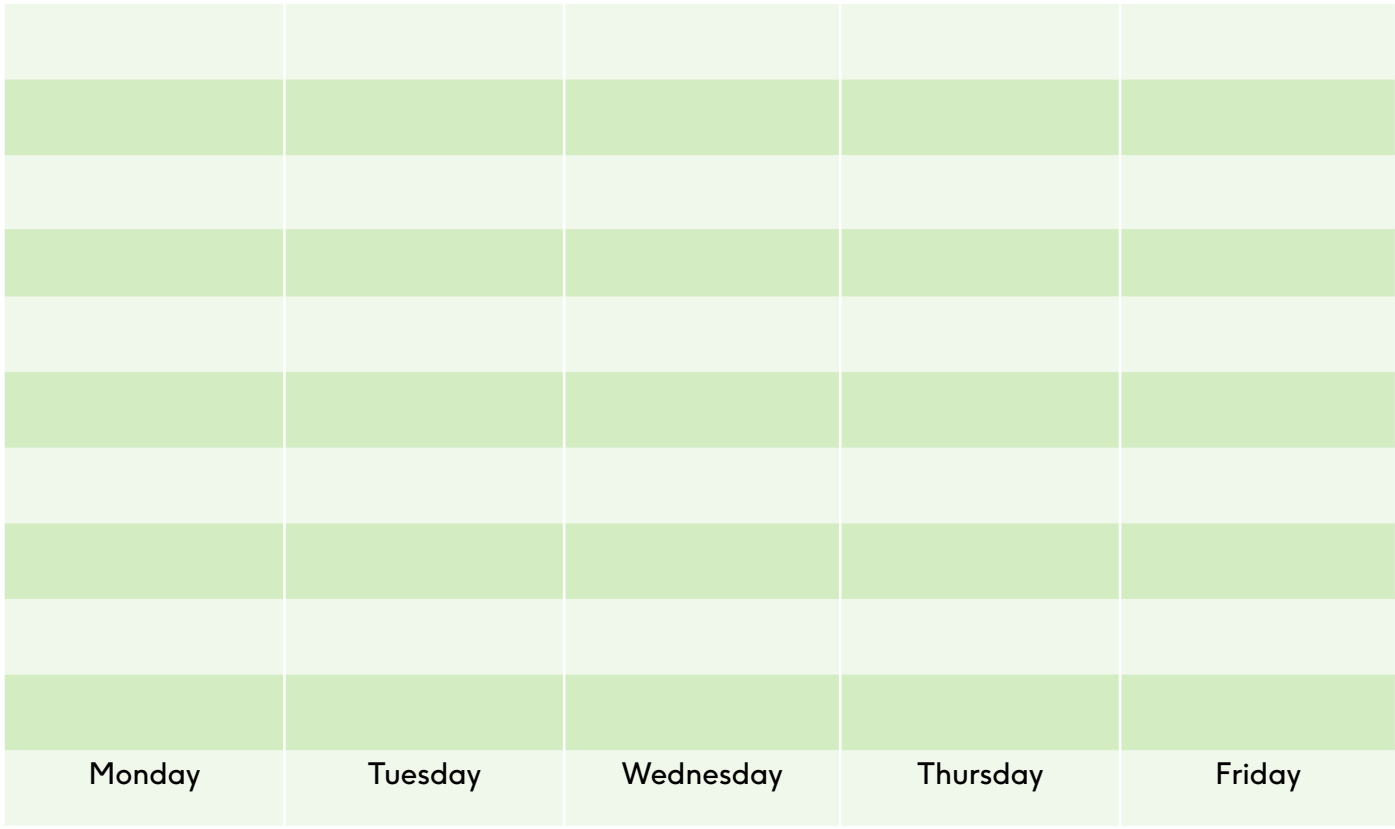
Complete the accompanying Weather Journal at the same time - Can you spot any patterns between the two sets of results?

	Monday	Tuesday	Wednesday	Thursday	Friday
DATE					
7am					
8am					
9am					
10am					
11am					
12pm					
1pm					
2pm					
3pm					
4pm					
5pm					
6pm					
kWh produced between 7am & 6pm					

UNIT FOUR
USING THE DATA SHEETS

Solar Sheet 2: Data Graph

Use the total electricity produced each day that you calculated on Solar Sheet 1. Plot the totals on the graph below:



Questions:

1. On average, what time of the day is the most electricity generated?
2. Why do you think this is?
3. How do you think the amount of energy generated will change depending on the seasons? Why?

UNIT FOUR
USING THE DATA SHEETS

Solar Sheet 3: Weather Journal

Complete the Weather Journal below:

Questions:

Compare your weather journal with your graph of average electricity produced.

1. What effects has the weather had on the amount of electricity the solar farm has produced?
2. Can you spot any patterns between the two sets of results?

Extension

a. Whilst you are filling in your weather journal, take a measurement of the temperature at the same time each day.

b. If you repeated this exercise in another season, what difference would there be in the results?

Complete the boxes using the key below:	Monday	Tuesday	Wednesday	Thursday	Friday
Is it cloudy? 0 No 1 Some clouds 2 Very cloudy					
Is it raining? 0 No 1 Some rain 2 Raining heavily					
Air Temperature 0 Hot 1 Warm 2 Cold					
Fill in the number of kWh the solar farm produced each day, as recorded on Solar Sheet 1	kWh	kWh	kWh	kWh	kWh

UNIT FIVE
USING THE SOLAR KIT

Work in pairs to build your own solar circuit

A solar circuit works in the same way as a regular electrical circuit, except the battery is replaced with a solar cell, powered by sunlight

What you will need:

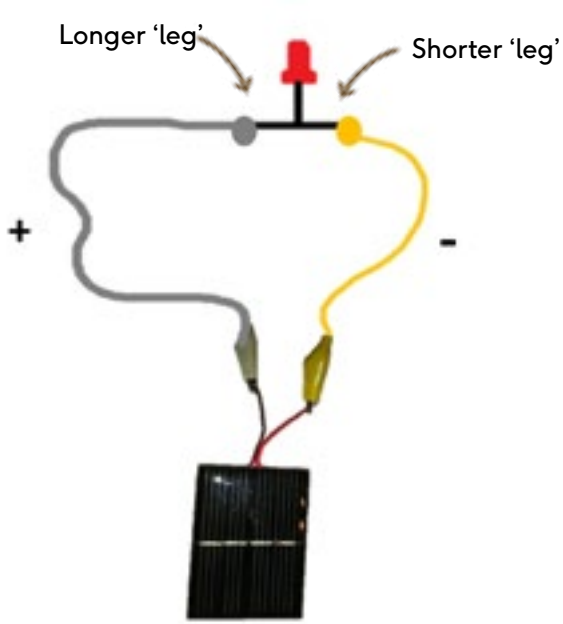
- An LED (bulb)
- 2 x crocodile clip wires
- A photovoltaic (PV) solar panel

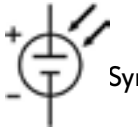
Instructions:

- Gently bend the 'legs' of the LED outwards
- Attach the longer 'leg' of the LED to the positive wire on the solar panel using a crocodile clip wire
- Attached the shorter 'leg' of the LED to the negative wire on the solar panel, ensuring the crocodile clips do not touch

NOTE: The LED will not work if it is attached the other way round

Once completed, your solar circuit should look like this:





Symbol for a Solar Cell

Symbol for an LED

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UNIT FIVE
USING THE SOLAR KIT

Draw a picture of your circuit:

Draw a diagram of your circuit using symbols:

Trouble Shooting

If your bulb won't light up, double check -

- The LED is connected the right way round
- The crocodile clips are not touching each other
- The panel is in strong sunlight or very close to a desk lamp

DISCUSSION:

What happens to the brightness of the bulb when you vary the strength of the sunlight? Try moving the solar cell towards the lamp, or further away.

TEACHING RESOURCE
LESSON IDEAS

English

1. Hold a 'Question Time' debate to explore different opinions about climate change. Follow up by exploring where students' own views are aligned and how they feel about climate change.

2. Use persuasive writing to convince a variety of audiences in different media about the benefits of solar technology, e.g. a newspaper article, blog, letter to MP asking to support the case for solar power in the UK.

3. **DEBATE:** Should the UK government subsidise solar for every household in Britain?

4. **DRAMA:** The students take on roles within a small town community (e.g. councillor, teacher, small business owner, student, farmer). A farmer has put in a planning request to turn some of their fields into a solar farm. Hold a town council meeting debating the request and whether it should be approved.

Design & Technology

1. Run a project around designing for the future and 'wicked problems', looking at solar as an alternative energy source for developing countries.

   Full unit lesson plans and supporting PowerPoint available here:
   http://old.solar-aid.org/sunnyschools/blog/Wicked%20Problems%20SolarAid%20lesson%20plans.pdf

2. Build a solar car. Instructions can be found here, under 'files/solar detective pack' :
   http://www.nationalstemcentre.org.uk/elibrary/resource/6338/solar-detectives

General Studies

1. Where do solar panels come from? Track a journey from raw materials through the manufacturing process to installation.

2. Explore partnering with a school in Africa to help them get solar panels installed on their roof:
   http://www.solar-aid.org/lighterlearning

3. Plan and run a campaign to raise awareness about climate change within the school or local community.

4. Use this interactive climate change game from DEFRA to see the impacts of individual actions to counter climate change:
   www.logicity.co.uk

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