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Land Rover BAR is the British Challenger for the 35th America's Cup – the oldest international sporting competition in the world. There are only six crew on the race boat, but dozens of experts are back at the team base working hard to help Land Rover BAR design the most technically advanced and innovative racing catamaran to win the America's Cup. The Land Rover BAR team also aims to be as sustainable as possible. They monitor how they create carbon emissions that add to global warming, and find ways to reduce these emissions.

**Dr Susie Tomson – Sustainability Manager**

Since Susie has been Sustainability Manager, she has helped to ensure that 100% of electricity at the Land Rover BAR base is from renewable sources.

## 1

Dr Susie Tomson, the team's Sustainability Manager, helps every team member understand the basics about how carbon emissions add to global warming. Write a brief definition of each term:

| | |
|---|---|
| Atmosphere | |
| Carbon cycle | |
| Greenhouse gas | |
| Greenhouse effect | |
| Fossil fuel | |
| Climate change | |
| Global warming | |
| Carbon reservoir | |
| Carbon sink | |

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The Land Rover BAR team base is designed to be very sustainable. However, the team still uses a lot of electricity to power the offices and workshops.

**2** Roughly what percentage of the atmosphere is carbon dioxide?

.....

**3** How was carbon from the early atmosphere trapped in rocks and fossil fuels?

.....

.....

.....

**4** Use the **carbon cycle** to explain how using electricity from fossil fuels adds to the greenhouse effect.

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Did you know the Land Rover BAR base is powered by solar panels?
The solar panels installed at Land Rover BAR have a capacity of 114 kW.
That's enough to power over 700 televisions!

**5** Why does using solar panels help Land Rover BAR reduce its carbon emissions?

.....

.....

.....

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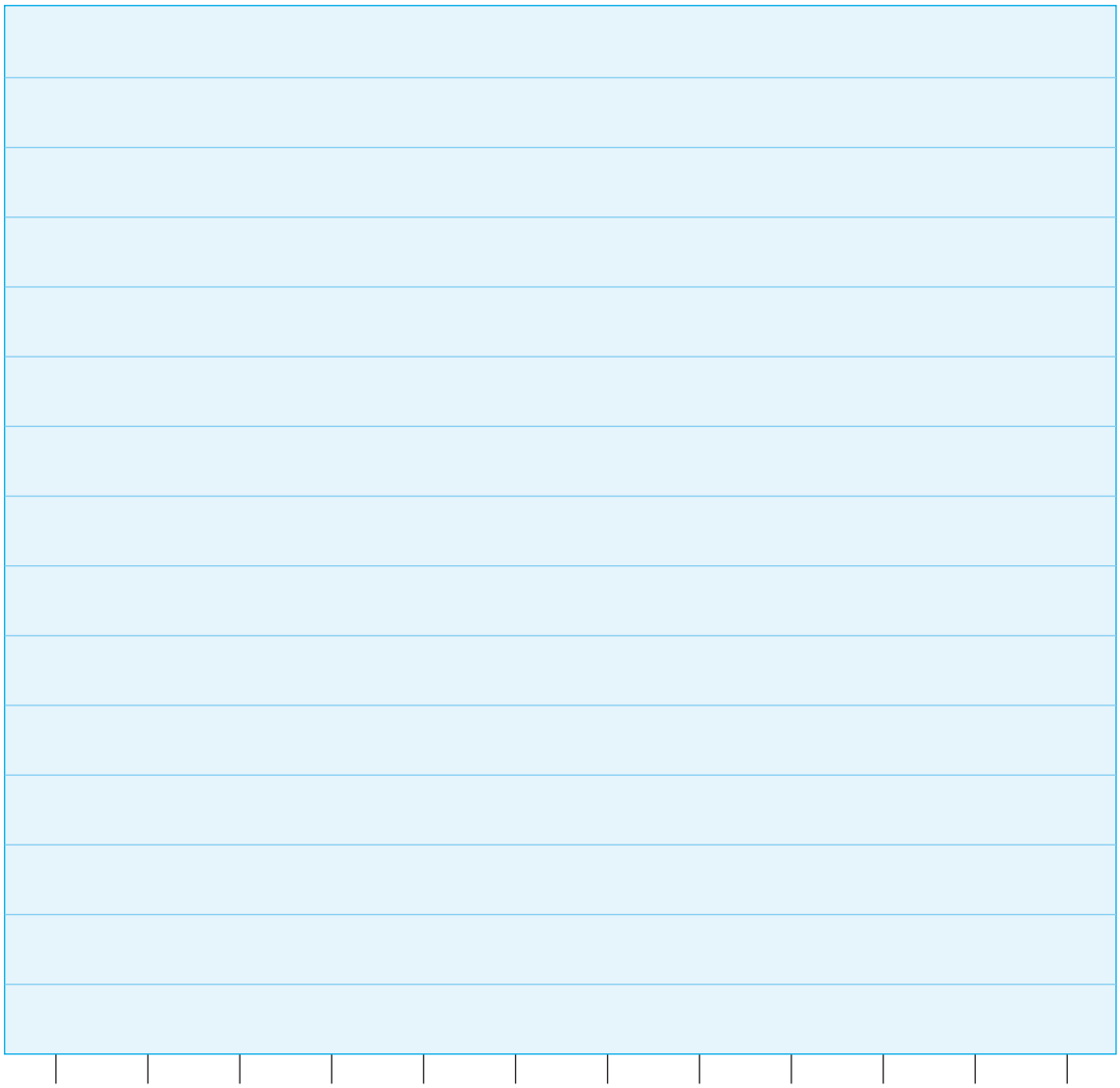
## 6 Dr Tomson monitors the building's environmental performance, including how much electricity is generated and used. Some data is missing.

Draw two line graphs on the chart to show the solar electricity generated each month and the total electricity used at the Land Rover BAR base. Don't forget to label each line!

| Month | Aug 2015 | Sep | Oct | Nov | Dec | Jan 2016 | Feb | Mar | Apr | May | Jun | Jul | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar production (kWh) | 10,400 | 9,800 | | 2,000 | 1,500 | | 4,000 | 8,400 | | 15,000 | 12,600 | 14,600 | |
| Total use (kWh) | 52,600 | 52,700 | 55,000 | 51,400 | 48,100 | 59,300 | 59,700 | 65,400 | 63,300 | 66,000 | 65,000 | 73,000 | |



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**a** Use your graph to **estimate** the three missing values for solar production and add your estimates to the table.

**b** How much solar electricity does the base generate between August 2015 and July 2016?

.....

**c** How much carbon emissions are saved in the year thanks to generating solar electricity? Use 0.527 kg of carbon per kWh.

.....

**d** In which month did the base save the most carbon by generating solar electricity?

.....

Calculate how much was saved in this month. Use 0.527 kg of carbon per kWh.

.....

**e** In which month does the base need to buy in the most electricity?

.....

**f** How much carbon does Land Rover BAR save by using renewable energy sources?

.....

**g** The average carbon emissions for a new car are 0.119 kg per mile. What is the size of the team's annual carbon emissions savings, expressed as its mile equivalent?

.....

## Challenge!

Land Rover BAR and Low Carbon collaborated to install solar panels on Northern Parade School, near the Land Rover BAR base in Portsmouth.

The school's roof was covered with 240 panels. Each panel can generate a peak output of 280 watts of electrical power. How many kilowatts of electrical power can the 240 panels produce in total at any one time, at peak output?

.....

An average home uses a maximum of about 7.7 kW of electrical power at any one time. How many homes could the installation power during peak demand, at peak output?

.....

# ANSWERS

**1**

| | |
|---|---|
| Atmosphere | The gases that surround the Earth. |
| Carbon cycle | How carbon constantly moves from one place to another in the environment. |
| Greenhouse gas | A gas that causes the atmosphere to warm. |
| Greenhouse effect | The trapping of the Sun's warmth in the atmosphere. |
| Fossil fuel | A natural fuel formed in the past from the remains of plants or animals. |
| Climate change | Changes to weather patterns around the world due to human influence. |
| Global warming | The gradual increase in the Earth's average temperature. |
| Carbon reservoir | A place where carbon is stored for a very long time. |
| Carbon sink | A place where carbon is absorbed from the atmosphere. |

**2**

About 0.04%, or 400 parts per million.

**3**

Through photosynthesis, plants stored the carbon in their trunks and roots. When the plants died and decayed, their remains were covered by layers and layers of sand and clay, and this changed to rock. As more rock built up on the remains, the weight caused high levels of pressure and this converted over millions of years into fossil fuels.

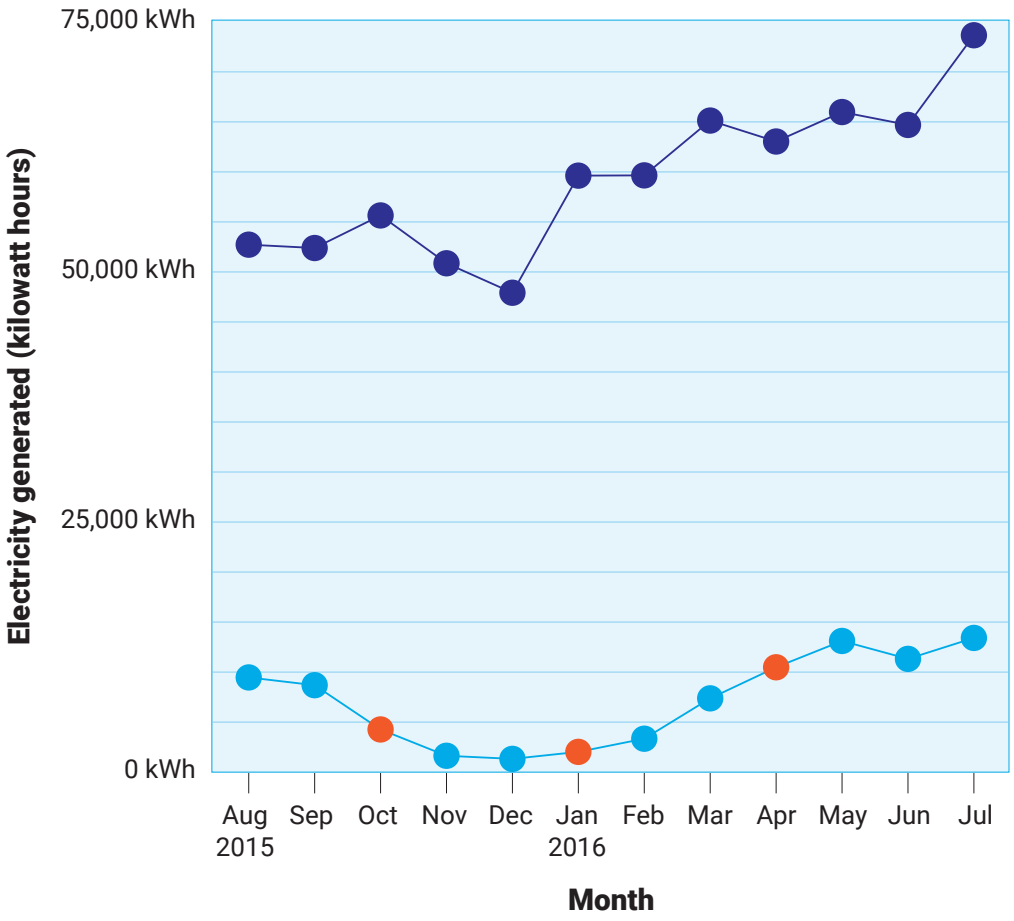
**4**

Combustion of fossil fuels releases carbon that was stored underground in fossil fuels for millions of years (a carbon reservoir), adding to the carbon stored in the atmosphere, which is a greenhouse gas.

**5**

When solar panels generate electricity they don't require fossil fuels to be combusted, so no carbon is released into the atmosphere.

**6**




**b** 96,200 kWh

**c** 50,697.4 kg carbon are saved (96,200 kWh x 0.527 kg).

**d** May, when 15,000 kWh were produced, saving 7,905 kg carbon (15,000 kWh x 0.527 kg).

**e** July, when they must buy 58,400 kWh (73,000 kWh - 14,600 kWh).

**f** 58,400 kWh of renewable electricity saves 30,776.8 kg carbon (58,400 kWh x 0.527 kg).

**g** In a year the team used 711,500 kwh electricity in total and because this was 100% renewable it saved 374,960.5 kg carbon (711,500 x 0.527 kg), equivalent to 3,150,929 miles (374,960.5 kg ÷ 0.119 kg) of car driving!

## Extension

The panels produce 67.2 kW of power (240 panels x 280 watts). This could power over eight homes (67.2 kW ÷ 7.7 kW = 8.7).