

Name:

Grade:

School:

Date:

WithOnePlanet

- > Module 1:
Carbon
- > Level:
Years 7 to 8
- > INQuIRY:
Investigate
- > Lesson 5:
Life's a carbon
balancing act
- > Student worksheet



Investigate

Lesson 5

Student worksheet

Life's a carbon balancing act

Years **7** to **8**



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INQuIRY     

WithOnePlanet

Open education
An xpend Foundation initiative

Life's a carbon balancing act

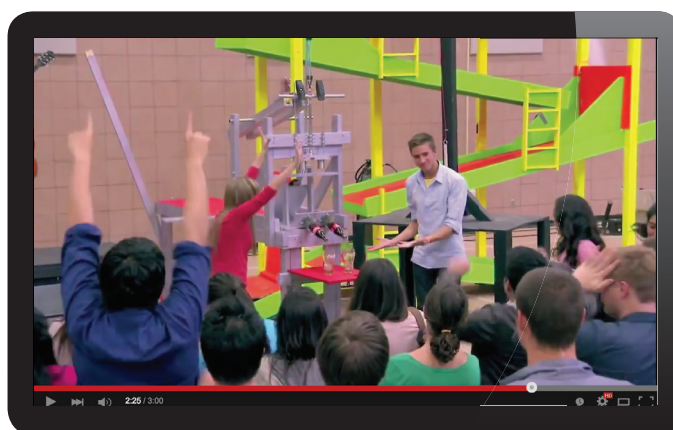
Lesson 5: Student worksheet

Activity 1: It's all about carbon

Watch the following video about carbon and then answer the questions below.



'Episode 4: Global Warming, It's all about carbon' from YouTube
<http://youtu.be/EvphJO8VKlc1>



Q1: What similar thing happens when someone eats a carrot, revs their motorbike engine or burns some paper?

Q2: If the bonds between carbon atoms are broken, what other element does carbon prefer to bond with?

Q3: What happens to carbon dioxide that floats out over the ocean?

Q4: What happens to carbon dioxide that floats out over trees in a forest?

Q5: What happens when sunshine hits carbon dioxide molecules?

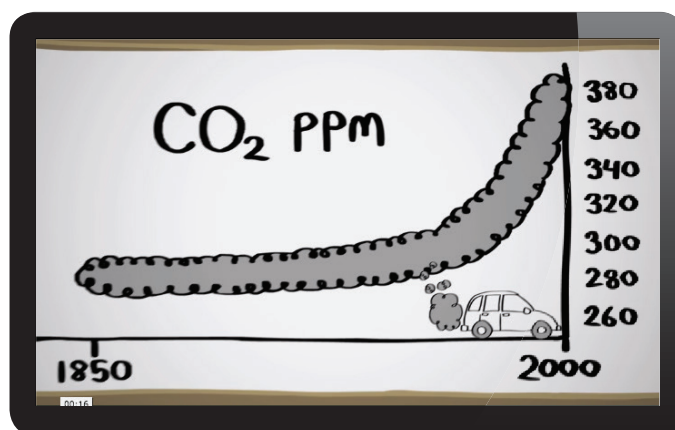
Activity 2: The climate in a nutshell

Watch the following two episodes of Climate Science in a Nutshell, and then answer the questions below.
(Watch Episode 5 before watching Episode 4.)



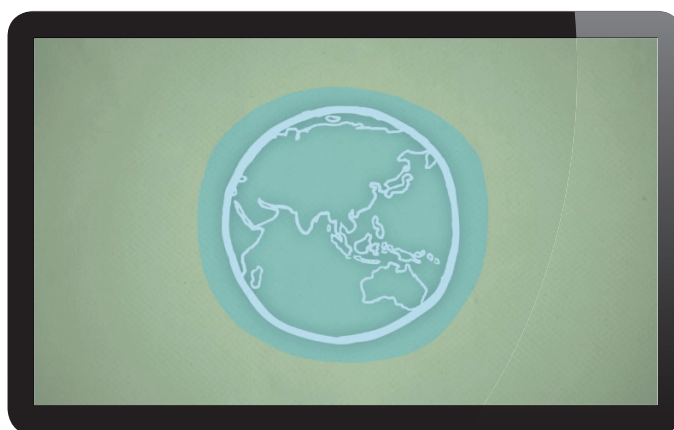
Climate Science in a Nutshell #5: *Where Does Carbon Dioxide Come From?* from Vimeo:

<http://vimeo.com/197965602>



'Climate Science in a Nutshell #4: *Too much carbon dioxide*' from Vimeo:

<http://vimeo.com/197974873>



Episode 5 Questions

Q1: What is the current carbon dioxide concentration of our atmosphere (in ppm)?

Q2: What do all our modern inventions require that results in carbon dioxide emissions?

Q3: Where does most of the energy we use to power our lifestyles come from?

Q4: How does an increase in carbon dioxide concentration affect Earth's temperature?

Q5: What do most scientists and many governments of the world believe is the safest maximum carbon dioxide concentration for the planet?

Episode 4 Questions

Q1: What are two advantages of Earth's atmosphere for life on Earth?

Q2: What are two advantages of sunlight penetrating the Earth's atmosphere?

Q3: Why does Earth's atmosphere act like a blanket?

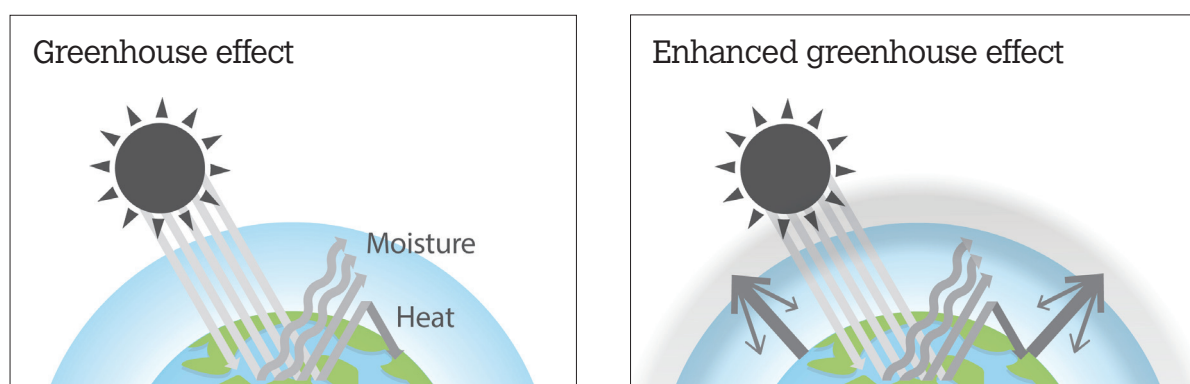
Q4: What is the greenhouse effect?

The greenhouse effect VS the ENHANCED greenhouse effect

Whenever you hear about or read about Earth's rising temperature, the idea of the 'greenhouse effect' is not far behind. However, most of the information you read, watch and hear is not as accurate as it could be.

The greenhouse effect is the Earth's way of keeping the planet at a relatively stable temperature. This means that life on Earth can survive and prosper. It's the **ENHANCED** greenhouse effect that causes all the problems. The **ENHANCED** part of the term refers to all the human activities, such as burning coal and using petrol in our cars, which cause the greenhouse effect to be greater than normal.

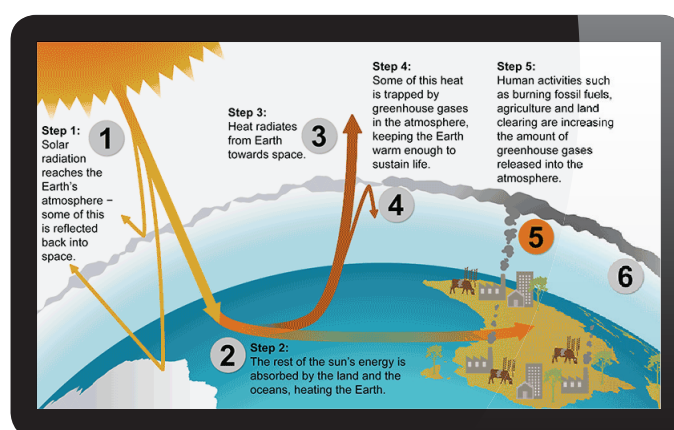
Have a look at the diagram below, which compares the greenhouse effect with the **ENHANCED** greenhouse effect.



Let's now look at how the enhanced greenhouse effect works step by step.



Have a go at this animation <http://www.environment.gov.au/system/files/pages/a07ddf8a-0821-449c-a6c1-700a7616a71c/images/greenhouse-effect-animation.gif>



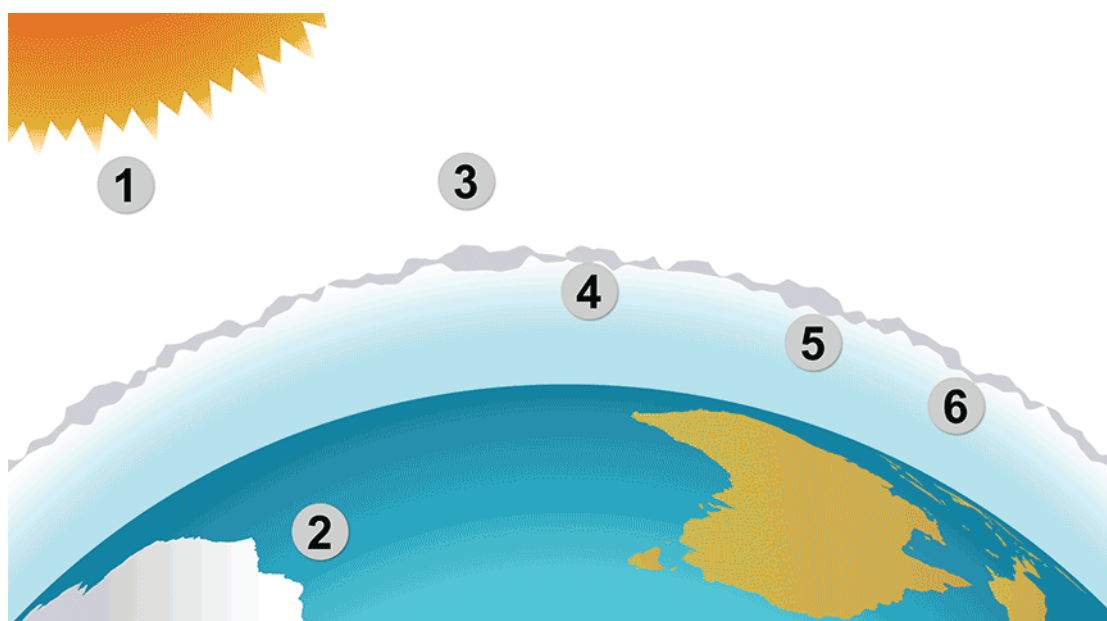
Sources:

WithOnePlanet, *Greenhouse effect and enhanced greenhouse effect infographics 2015*

Australian Government Department of Education, *Enhanced greenhouse effect*, [Online Video], viewed 24 February 2015, <<http://www.environment.gov.au/system/files/pages/a07ddf8a-0821-449c-a6c1-700a7616a71c/images/greenhouse-effect-animation.gif>>

Once you have understood what happens in each step of the enhanced greenhouse effect, summarise your understanding on the blank version below. To do this you will need to add:

1. the correct arrows (Make sure they have the correct thickness and colour.)
2. any additional images, such as in Step 5
3. detailed labels **in your own words**. (Do not simply copy out the descriptions on the animation.)



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

The REALLY enhanced greenhouse effect!

Here's your chance to get creative while teaching others about the enhanced greenhouse effect.

In this activity, you are going to make stop-motion video of the process of the enhanced greenhouse effect – now that's REALLY enhancing the greenhouse effect!

What's stop motion?

Never seen a stop motion video, let alone made one of your own?

Stop motion is an animation technique where a video camera is repeatedly stopped and started to make an object appear to move on its own. Alternatively, a photographic camera can be used to take successive photos of an object that is moved a very small amount between photographs. These photos are then edited together in a sequence that makes the object appear to move.

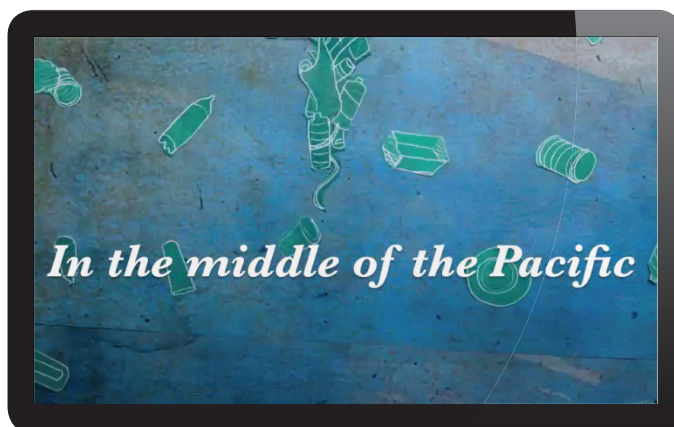
Check out some of these stop motion videos, which range from the incredible to the achievable at the Year 7 & 8 student level. Simply amazing!



Gulp. The world's largest stop-motion animation set shot on a Nokia N8: <http://youtu.be/ieN2vhsITTU>⁵



Great environmental animations: There's no place like earth.mov: <http://youtu.be/Wx4HSfP6pOc>⁶





Climate change stop motion: <http://youtu.be/D6mn9MDiZ70>⁷



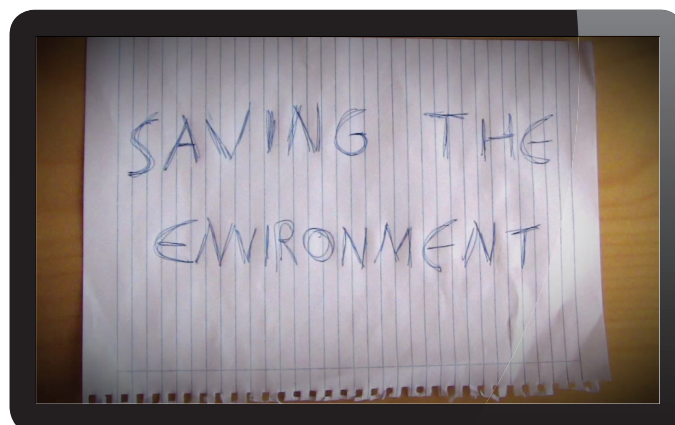
Videos that may give you some ideas for your own stop motion:



Global Warming Stop Motion Animation: <http://youtu.be/XMd8IXGrAQ0>⁸



Saving the environment: http://youtu.be/Vkq_srFGW5I⁹



How can I make a stop motion video?

It's easy! (no ... really!)

We will be making our stop motion 'characters' out of regular coloured paper and then take photographs of them or film them in very short sequences.

As well as coloured paper, scissors, pens, pencils and your imagination, you will need access to the following equipment:

- > a digital still camera or movie camera
- > a computer
- > some video editing software such as
 - Windows moviemaker or JPG Video for Windows devices
 - iMovie iStopMotion for Apple devices
 - Stopmotion for Linux devices.



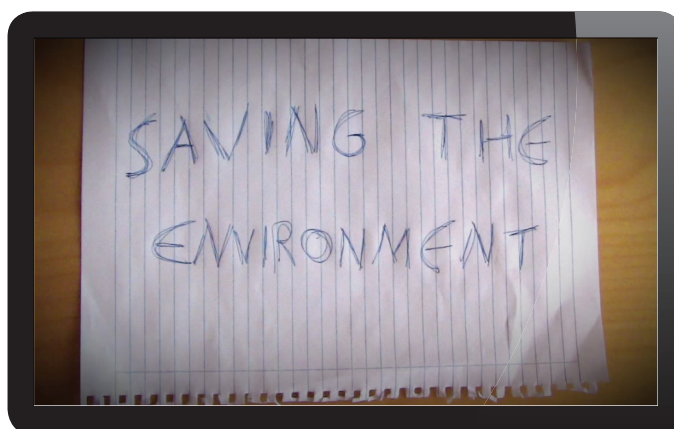
Here's a short video that explains how to use Window's Moviemaker to produce your stop motion video:

<http://youtu.be/TBINKsMkGSc>¹⁰



Here's a short video that explains how to use iMovie to produce your stop motion video:

<http://youtu.be/ipE3nCjI0IU>¹¹



What should I include in my video?

Your video needs to teach others about the enhanced greenhouse effect. Therefore, it will be important to explain how the enhanced greenhouse effect works using simple images and either voiceover or written text to explain what is happening in the images.

Your video doesn't need to be very long, but it needs to include all the steps that you saw in the animation.

What are the steps?

Sources

1. NPR 2009, Episode 4: *Global Warming, It's All About Carbon*, [Online Video] 3 February, viewed 31 December 2013, <<http://youtu.be/EvphJO8VKlc>>
2. Planet Nutshell 2011, Climate Science in a Nutshell #5: *Where Does Carbon Dioxide Come From?* [Online Video] 10 February, viewed 1 January 2014, <<http://vimeo.com/19796560>>
3. Planet Nutshell 2011, Climate Science in a Nutshell #4: *Too Much Carbon Dioxide*, [Online Video] 10 February viewed 1 January 2014, <<http://vimeo.com/19797487>>
4. Australian Government – Department of Environment 2013, *Enhanced Greenhouse Effect*, viewed 1 January 2014, <<http://www.climatechange.gov.au/greenhouse-effect>>
5. Nokia 2011, Gulp. *The world's largest stop-motion animation set shot on a Nokia N8*, [Online Video] 2 August, viewed 1 January 2014, <<http://youtu.be/ieN2vhsITTU>>
6. TheLaura3990 2011, *There's no place like earth.mov*, [Online Video] 7 November, viewed 1 January 2014, <<http://youtu.be/Wx4HSfP6pOc>>
7. Anders1028 2011, *Climate Change Stop Motion*, [Online Video] 24 June, viewed 1 January 2014, <<http://youtu.be/D6mn9MDiZ70>>
8. Maria João Marques 2011, *Global Warming Stop Motion Animation*, [Online Video] 4 June, viewed 1 January 2014, <<http://youtu.be/XMd8IXGrAQ0>>
9. Thanos Nikopoulos 2012, *Global Warming Stop Motion Animation*, [Online Video] 4 July, viewed 1 January 2014, <http://youtu.be/Vkq_srFGW5l>
10. BeauHD 2009, *How to Make a Stop Motion Film*, [Online Video] 22 September, viewed 1 January 2014, <<http://youtu.be/TBINksMkGSc>>
11. Matthew Pearce 2010, *iMovie Stop Motion Tutorial*, [Online Video] 1 August, viewed 1 January 2014, <<http://youtu.be/ipE3nCjIOIU>>

Activity 3: The great energy debate! – Student worksheet

Could Australia rely on 100% renewable energy to power all its activities? Should Australia rely on 100% renewable energy to power all its activities?

These are questions without easy answers and many different opinions. Ask an energy company spokesperson and an environmental scientist and you are sure to get completely different answers.

What do you think? Suppose you were placed in the environmental scientist's or the energy company spokesperson's shoes – How would your opinion change? What if you were asked to decide on Australia's energy future – What decision would you make?

Although designed for a UK audience, the Energy Nation interactive at E.ON UK's Energy Experience website can give you an idea if Australia is ready for the challenge.

Access the interactive here: <http://www.eon-uk.com/EnergyExperience/479.htm>¹

This interactive takes a look at the renewable situation from 6 different perspectives:

The energy company, the carbon tsar, the power generator, the government, the environmental scientist and the homeowner.

In this activity, you and your group will become an expert from one of the 6 perspectives and write a speech that attempts to convince your audience – the whole of Australia! – that your perspective is the right one for Australia's energy future.

At all times, it is important not to lose track of what the issue or topic for the debate really is. For this debate, the topic you will be debating is:

**Australia should become powered
by 100% renewable energy by 2020.**

Your expert group will need to decide whether or not you agree or disagree with this statement before writing your speech.

Sounds complicated? Don't worry – just follow the steps on the next page ...

Step 1: Form an expert group

An expert group is a group of learners who will work together to learn about one of the 6 perspectives on renewable energy, form an educated opinion from that perspective, and help each other to develop an argument to convince others of that opinion.

Expert groups

The Expert groups for this activity are listed below.

<p>Expert group 1</p> <p>The energy company spokesperson</p>	<p>Expert group 2</p> <p>The carbon tsar</p>	<p>Expert group 3</p> <p>The power generator spokesperson</p>
Add names here:	Add names here:	Add names here:
<p>Expert group 4</p> <p>The government spokesperson</p>	<p>Expert group 5</p> <p>The environmental scientists</p>	<p>Expert group 6</p> <p>The homeowner</p>
Add names here:	Add names here:	Add names here:

Please assemble into your Expert groups, and together, move to the next step.

Step 2: Complete the interactives

You can access the interactive here: <http://www.eon-uk.com/EnergyExperience/479.htm>¹

Click on the correct expert from the menu on the left hand side of the page.

Complete all of the games and activities you find there.

Step 3: Conduct additional research

The interactives are based on information from the UK, not Australia. It will therefore be difficult to form a considered opinion for Australian conditions unless you conduct some additional research.

Before you begin to research, it is good to work out exactly what information you are looking for. Complete the table below to do this:

Expert group #:	Perspective:
What further information do I need to find out about renewable energy in Australia from this perspective?	What other questions does a person from this perspective have about renewable energy?
<p>Now conduct your research. What information/answers have I found out?</p>	

Step 4: State your contention

A contention is just another name for a considered opinion. Will your group choose to agree with the debate topic, or will you choose to disagree?

Remember that the topic you will be debating is:

**Australia should become powered
by 100% renewable energy by 2020.**

Remember that you are not debating this topic from your own perspective. You are debating it from the perspective assigned to your expert group. So your personal opinions are not useful in this context.

You will need to have a group discussion to decide on your contention. The interactives and the additional research you have completed should help you to move towards a consensus.

Step 5: Develop your arguments

Once your group has made a decision about whether to agree or disagree with the topic statement, it is time to develop the arguments – **from the perspective of the expert that you are representing** – that will convince others of your contention.

Remember that you are not debating this topic from your own perspective. You are debating it from the perspective assigned to your expert group. So your personal opinions are not useful in this context.

When developing your arguments, it is important that they are justified or backed up by solid evidence. Giving an opinion and not providing the reasons behind it will not convince anyone of your standpoint.

You may find the flowchart below a helpful way to approach the writing of each of your arguments. Use the blank template of this flowchart on the next page as many times as you need.

HINT: It is good to have at least three well-explained and justified arguments to back up your contention.

Your group's perspective:



Your group's contention: (Do you agree or disagree with the debate topic?)



A brief statement of the arguments in favour of your contention:



Evidence to back up your arguments: (e.g. facts from reputable sources, expert opinions, reliable data – graphs tables etc.)



Sources of your evidence: (Remember that evidence is only reliable if the source is known and trusted!)

Step 6: Write your speech

As a group, you will need to write a short speech – maximum 3 minutes – that:

- > states your contention from your group's expert perspective (Step 3)
- > uses the arguments you researched and produced (Step 4).

And attempts to convince your audience that your perspective is the correct one.

Throughout your speech, it is important to regularly return to the topic that you are debating:

**Australia should become powered
by 100% renewable energy by 2020.**

Your group will also need to select someone to present your speech. Try choosing someone who has a convincing manner and is able to speak slowly and clearly.

Good luck!

Sources

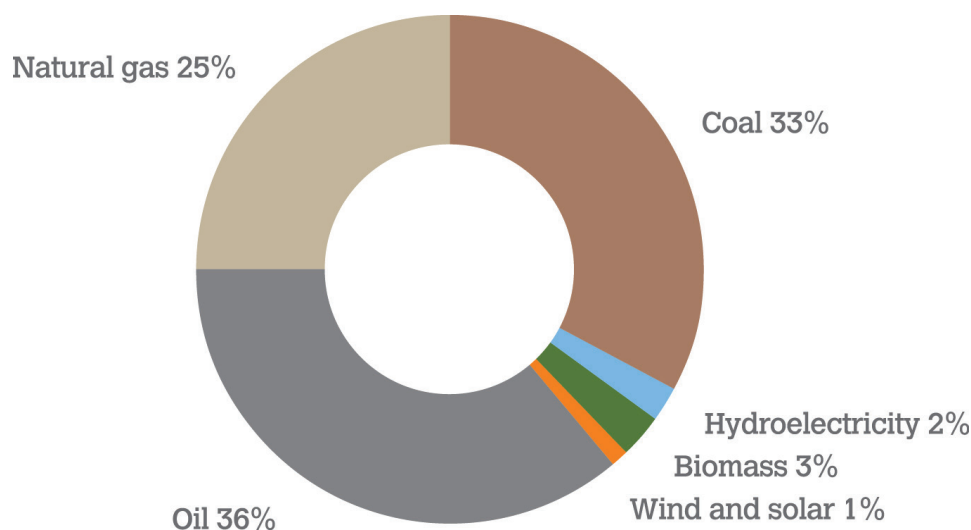
1. E.ON UK 2013, Energy Experience - *Energy Nation*, viewed 1 January 2014, <<http://www.eon-uk.com/EnergyExperience/479.htm>>

Activity 4: Reduce and renew – Student worksheet

REDUCE: Using less energy from fossil fuels

The majority of Australia's energy comes from fossil fuels. Observe the pie chart below that shows the types of energy used by Australians, and answer the following questions.

Australia's primary energy consumption, 2011



Q1: In 2011, what total percentage of Australia's energy came from fossil fuels?

Q2: In 2011, what total percentage of Australia's energy came from renewable resources?

It is important to note that households only use 25% of the total energy used by Australians, with another 25% being used by business, and the majority – 50% - being used by mining, manufacture and agriculture.

Sources

Source: U.S. Energy Information Administration 2011, *Australia's primary energy consumption 2011*, viewed 1 January 2014, <<http://www.eia.gov/countries/cab.cfm?fips=as>>

Q3: In the space below, draw a pie chart to represent the proportions of Australia's energy used by households, business and mining, manufacturing and agriculture.



One of the many consequences for continuing to produce such a large proportion of our energy from fossil fuels is that Australia's greenhouse gas emissions will continue to rise. According to 2012 statistics, Australia generates about 1.5% of the world's greenhouse gas emissions.

However, per person, Australia is one of the world's largest polluters. For the year to June 2012, Australia produced an average of 24.4 tonnes of carbon dioxide equivalent (CO₂e) per person. Only a few countries in the world rank higher — Bahrain, Bolivia, Brunei, Kuwait and Qatar.

Australia's CO₂ emissions per person are more than four times the world average.

Q4: See if you can find the countries of Bahrain, Bolivia, Brunei, Kuwait and Qatar on a world map.

a. In what particular region of the world are all of these countries located?

b. Why do you think that these countries have higher average carbon dioxide emissions, per person, than Australia?

c. Why do you think that Australia ranks so highly in carbon dioxide emissions by world standards?

RENEW: Using more energy from renewable resources

One way that Australia can use less fossil fuel and therefore emit less carbon dioxide is to start using more energy from renewable sources.

Although Australia is rich in coal, it also happens to be rich in renewables, such as sunlight, wind, waves, biomass and uranium, all of which produce energy without emitting carbon dioxide.

Australia has some of the best solar and wind resources in the world but these are vastly under-utilised.

One Australian research and education organisation – Beyond Zero Emissions – believes that if we put our minds to it, Australia could become powered by 100% renewable resources in 10 years.

Take a look at what they have to say over the page.

100% Renewable Energy in 10 Years

100% Renewable

Australia can – and must – move quickly to zero carbon energy. We could make the shift to 100% renewables in a decade using wind and solar thermal with storage. The \$370 billion cost, less than 4% of GDP, would reap fossil fuel savings of \$1.6 trillion by 2040.

This bold plan will help end the global stalemate on climate action, make Australia a world leader in the low-carbon economy of the future, create 80,000 high-quality ongoing jobs (more than the fossil energy supply workforce) and build lucrative export industries.

Australia – energy superpower

Australia has the best solar resource of any developed country, perfectly complemented by a world-class wind resource along our southern coast and Tasmania.

Why 100% in 10 years?

Australia's carbon budget

A global climate deal will only succeed if it is fair and ambitious enough to save the most vulnerable. The emissions pathway shown at top right, from Europe's chief climate advisor Prof Hans Schellnhuber:

- has just a 1% chance of keeping global warming below 2°C (so we actually need stronger action than they, like the pathway back to 250ppm CO₂ shown below right)
- within the limit, allocate the world's remaining emissions budget fairly based on population.

Note that Schellnhuber's pathway:

- doesn't account for past emissions (carbon debt), which would require even deeper cuts from USA and Australia
- doesn't include emissions trading – richer countries funding clean technology to help poorer countries avoid emissions growth.

24 hour solar power

Solar thermal power stations focus sunlight onto a boiler to generate steam, driving a turbine to make electricity. Some now use tanks of molten salt to store the heat and generate power later when needed. In Spain, 50 megawatt solar power stations installed in 2008 are operating 24 hours a day during summer.

Wind & solar across Australia

What you can do

- Learn more: read about the [Zero Carbon Australia 2020 plan](#) at [beyondzeroemissions.org](#)
- Spread the word: tell your friends and family; ask us for a presentation to your community or social group.
- Contact your MP: email, phone or visit your State or Federal MP. Ask them to speak out in support of 100% renewable energy for Australia.

Changing the mix

Under the Zero Carbon Australia 2020 plan, electrification of transport and space heating and energy efficiency reduce demand by 56%. The remainder is met with 60% solar thermal and 40% wind energy, plus biomass backup.

High-Speed Train

Electrical – 250 km/h, semi-extended to intercity travel

Solar Concentrator Array

60 hour daylight storage thermal electricity – Torrens, Adelaide

Wind Generation

Electrical generation average 10% contribution from wind energy (McKinnon 2009)

Is going 100% renewable achievable for Australia?

To find out the answer to this question, it is firstly important to gain a deeper understanding of the different types of renewable energy that are available in Australia and how they can be used to generate electricity.

Although designed for a UK audience, the Energy Nation interactive at E.ON UK's Energy Experience website gives a comprehensive overview of the different types of renewable resources that can be used to generate electricity.

Source

Beyond Zero Emissions 2010, *Stationery Energy Plan Poster*, viewed 1 January 2014, <<http://www.eia.gov/countries/cab.cfm?fips=as>>

You can access the website here: <http://www.eon-uk.com/EnergyExperience/479.htm>¹ then click on **Energy Sources** in the lower left-hand column.

Complete the tables below for nuclear, hydroelectric, wind, solar energy and one other renewable energy of your choice. You are welcome to have a look at all the other types also.

Nuclear

What is it?	How is it used to generate electricity?	Where can you find it?
Advantages	Disadvantages	Your opinion: Should Australia move towards using more of this renewable resource? Why/why not?

Source

E.ON UK 2013, E.ON UK - Energy Experience – *Energy Nation – Energy Sources*, viewed 31 December 2013, <http://www.eon-uk.com/EnergyExperience/479.htm>

Hydroelectric

What is it?	How is it used to generate electricity?	Where can you find it?
Advantages	Disadvantages	<p>Your opinion:</p> <p>Should Australia move towards using more of this renewable resource? Why/why not?</p>

Source

E.ON UK 2013, E.ON UK - Energy Experience – *Energy Nation – Energy Sources*, viewed 31 December 2013, <<http://www.eon-uk.com/EnergyExperience/479.htm>>

Wind

What is it?	How is it used to generate electricity?	Where can you find it?
Advantages	Disadvantages	Your opinion: Should Australia move towards using more of this renewable resource? Why/why not?

Source

E.ON UK 2013, E.ON UK - Energy Experience – *Energy Nation – Energy Sources*, viewed 31 December 2013, <<http://www.eon-uk.com/EnergyExperience/479.htm>>

Solar

What is it?	How is it used to generate electricity?	Where can you find it?
Advantages	Disadvantages	Your opinion: Should Australia move towards using more of this renewable resource? Why/why not?

Source

E.ON UK 2013, E.ON UK - Energy Experience – *Energy Nation – Energy Sources*, viewed 31 December 2013, <<http://www.eon-uk.com/EnergyExperience/479.htm>>

Your choice: _____

What is it?	How is it used to generate electricity?	Where can you find it?
Advantages	Disadvantages	<p>Your opinion:</p> <p>Should Australia move towards using more of this renewable resource? Why/why not?</p>

Source

E.ON UK 2013, E.ON UK - Energy Experience – *Energy Nation – Energy Sources*, viewed 31 December 2013, <<http://www.eon-uk.com/EnergyExperience/479.htm>>