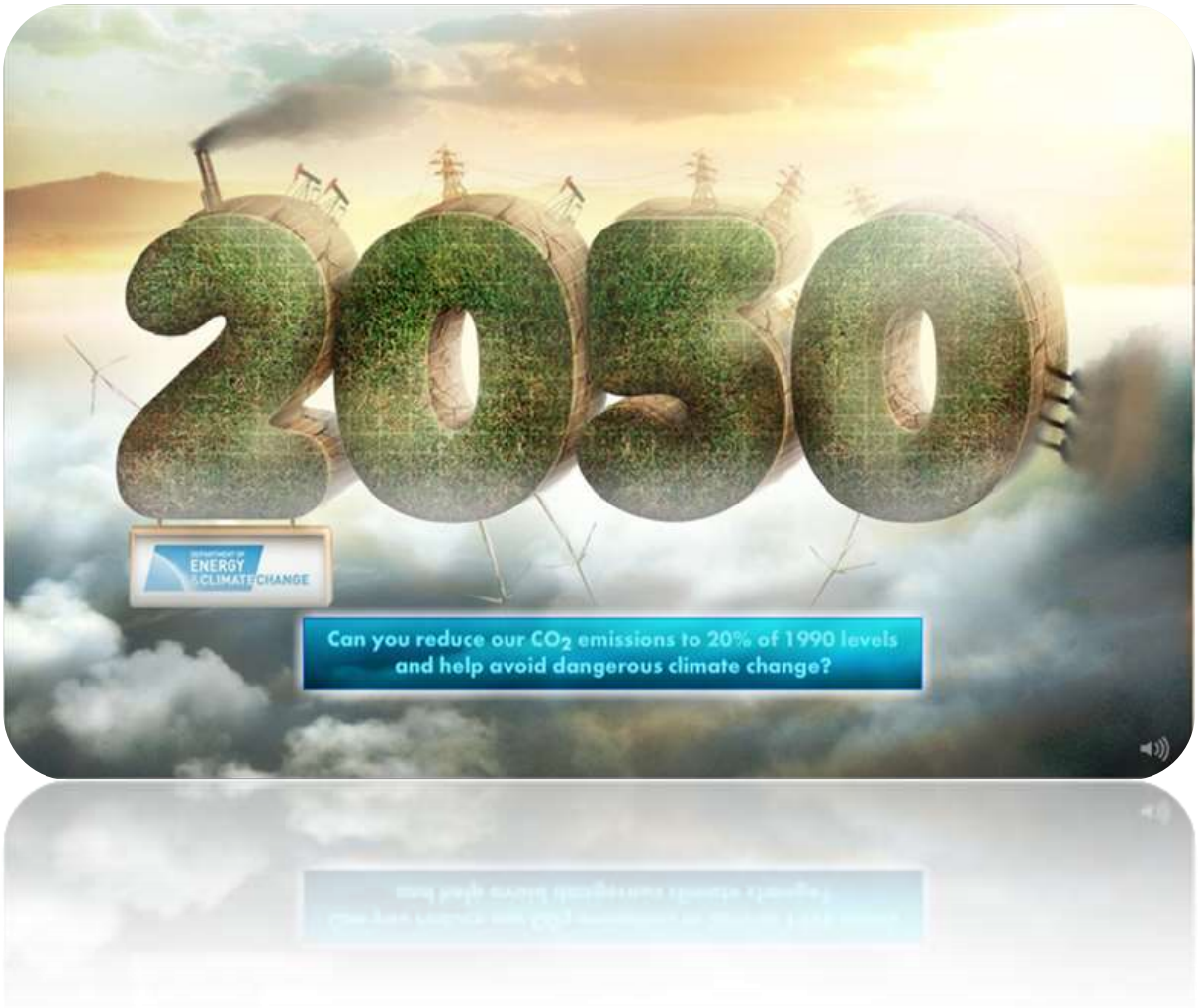
Department of Energy & Climate Change

The My2050 Schools Toolkit

A guide for teachers wanting to engage students in the climate change debate



This toolkit for KS3 and KS4 teachers has been developed by DECC in conjunction with Involve, Think Global and Sciencewise-ERC

Contents page

1. How to use this resource

This toolkit is a set of activities that can be used in the classroom to engage students in debates about climate change and energy. The first section of this resource provides background to climate change, curriculum links and learning outcomes for students. The second section suggests how to run a lesson using the My2050 simulation. Sections 3 and 4 provide websites with further resources and suggestions for additional activities. Supplementary materials for lesson activities can be found in the Annex.

1.1 Background on climate change

What is climate change?

Climate is the average weather experienced over a long period. This includes temperature, wind and rainfall patterns. Climate change refers to identifiable change in the climate that persists for an extended time, typically decades or longer.

Causes of climate change

The Earth's climate is not fixed. In the past it has changed many times in response to a variety of natural causes. However, the 2013 Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) suggests that human activity is the predominant cause of the warming observed, particularly over the last 50 years**.** The main human influence on global climate is the emission of greenhouse gases, such as carbon dioxide (CO_2), methane and nitrous oxide. As these gases build up in the atmosphere, they strengthen what is known as the greenhouse effect which leads to global warming.

Effects of climate change

- Rising temperatures – the average temperature of the Earth's surface has risen by about 0.8^{o}C since around 1900.
- Global average sea level continues to rise – likely to be 0.5m or more by the end of the century.
- Extreme weather – more frequent heat waves and heavy precipitation are already more likely in the coming decades in many regions.
- Increased risk of extinction for 20 to 30% of species and loss of biodiversity.
- Damage to marine ecosystems because of ocean acidification.

The social, environmental and economic costs of climate change could be huge if no global action is taken to reduce carbon emissions. You can find out more about the costs of climate change in the Stern report. Further information is available on the Department of Energy and Climate Change Website (DECC) website: www.gov.uk/climate-change-explained

1.2. Introduction to 2050 target and tools

The UK Climate Change Act 2008 requires the UK to reduce its carbon emissions by 80% below 1990 levels by 2050. By limiting the amount of carbon dioxide released into the atmosphere, we aim to reduce the rate and severity of global warming to 2°C since records began. It will require a transformation in the way the UK both generates and consumes energy. How will we reduce energy demand? Should we build more wind farms, rely on nuclear power or develop other sectors?

DECC is interested in engaging people across the UK in the debate about these major decisions. This is especially relevant for young people who will have to live with the consequences of decisions that are made now.

The My2050 simulation has been created to engage students in how these choices are made – choices that will affect the way they study, work and live between now and 2050.

You can watch an introduction to the energy challenge the UK faces on the DECC YouTube Channel, which can be used as an introduction to the lesson if your school allows access to YouTube. The YouTube video produced by the DECC Youth Panel is also a useful starting place for your lesson.

1.3. Who the resource is aimed at?

The resource has been designed for use in the citizenship, geography, science or maths curriculum. The target audience in schools is students between the ages of 11 and 16, but can be modified for use by younger or older students. The table below outlines the strands of the National Curriculum and various qualifications which the toolkit supports.

Key Stage 3	**Citizenship:** • Pupils should use and apply their knowledge and understanding while developing skills to research and interrogate evidence, debate and evaluate viewpoints, present reasoned arguments and take informed action. • The development of the political system of democratic government in the United Kingdom, including the roles of citizens, Parliament and the monarch. **Geography:** • Human geography relating to: population and urbanisation; international development; economic activity in the primary, secondary, tertiary and quaternary sectors; and the use of natural resources. • Understand how human and physical processes interact to influence, and change landscapes, environments and the climate; and how human activity relies on effective functioning of natural systems. **Science:** • The production of carbon dioxide by human activity and the impact on climate. • Calculation of fuel uses and costs in the domestic context – fuels and energy resources. **Maths:** • Select and use appropriate calculation strategies to solve increasingly complex problems. • Develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems. • Select appropriate concepts, methods and techniques to apply to unfamiliar and non-routine problems. • Construct and interpret appropriate tables, charts, and diagrams, including frequency tables, bar charts, pie charts, and pictograms for categorical data, and vertical line (or bar) charts for ungrouped and grouped numerical data.
Key Stage 4	**Citizenship:** • Pupils should develop their skills to be able to use a range of research strategies, weigh up evidence, make persuasive arguments and substantiate their conclusions. • Pupils should experience and evaluate different ways that citizens can act together to solve problems and contribute to society. • The different electoral systems used in and beyond the United Kingdom and actions citizens can take in democratic and electoral processes to influence decisions locally, nationally and beyond.

	• The different ways in which a citizen can contribute to the improvement of their community, to include the opportunity to participate actively in community volunteering, as well as other forms of responsible activity. **Geography:** • Changing weather and climate – The causes, consequences of and responses to extreme weather conditions and natural weather hazards, together with their changing distribution in time and space. The spatial and temporal characteristics, evidence for and causes of climatic change over the past two million years to the present day. • Resource management and biodiversity - How humans use, modify and change natural ecosystems in ways that may be sustainable or unsustainable. **Science:** • Explaining everyday and technological applications of science; evaluating associated personal, social, economic and environmental implications; and making decisions based on the evaluation of evidence and arguments. • potential effects of, and mitigation of, increased levels of carbon dioxide and methane on the Earth's climate • renewable and non-renewable energy sources used on Earth; changes in how these are used. **Maths:** • Develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems. • Plot and interpret graphs (including reciprocal graphs {and exponential graphs}) and graphs of non-standard functions in real contexts, to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration. • Infer properties of populations or distributions from a sample, whilst knowing the limitations of sampling

1.4. Learning aims

- Students will gain an understanding of the UK's legally-binding decision to reduce its carbon emissions by 80% of 1990 levels by 2050;
- Students will gain some understanding of the technological changes required to achieve this target in the UK; and
- Students will be given an opportunity to explore some of the individual, community and national changes needed to tackle climate change.

1.5. Learning outcomes and processes

Students will be able to:

- Outline the link between supply and demand in order to reach the UK's legally binding target to reduce its greenhouse gas emissions by 80% of 1990 levels by 2050;

- Identify the impact of the target on lifestyle choices for individuals, communities and the wider UK society;
- Discuss the range of options available to meet the energy needs of the UK.

Key processes:

Critical thinking; analytical enquiry; numerical skills; basic statistical analysis; empathising with others; discussion and debate; arguing a viewpoint other than your own; communicating ideas; listening to others; working with others to solve problems; advocating for policy change at local and/or national level; and taking informed and responsible action.

1.6. How to use the resource

The toolkit has been designed to be used flexibly so that teachers can adapt it for their students and school setting. The main activities are aimed at Key Stage 3 students, through to the differentiation options which are more suitable for Key Stage 4 students. The lesson can be delivered in citizenship, geography, science or maths and the options are clearly marked in the lesson toolkit.

The lesson is designed for a one hour session, or as part of a series of lessons with or without homework. The following timetable below is suggested, however you may wish to extend certain activities or even use the toolkit for a series of sessions.

- Starter activity ……10 minutes
- My 2050 simulation ……25 minutes
- Plenary activities by subject ……20 minutes
- Evaluation pledge cards ……. 5 minutes

Preparation and planning

The main activity is based on students being able to engage with the My2050 tool. Ideally you should book an ICT suite for students to use the website, but the lesson can be run through a whiteboard and computer with internet access.

Please test the website prior to running the class as you will need to ensure that you have updated versions of Adobe Flash to interact with the website. Students can share their solution with DECC at the end of the game without logging into the website. Students can also post their results through their Facebook or Twitter profile if your school allows access to these sites.

1.7. Lesson Plan

The following table gives an outline of the lesson, with different options depending on which session it will be delivered in. Supplementary materials for lesson activities are labelled according to subject. i.e. Citizenship (A), Geography (B), Science (C) and Maths (D) and can be found in the Annex. It is suggested that you run either activity (i) OR (ii) based on the class ability and time available.

<table>
<tr><th>Time (mins)</th><th colspan="4">Lesson Content</th></tr>
<tr><td>10</td><td colspan="2">1. Starter Activity</td><td colspan="2">Either option (a) Key Term Match-Up; OR (b) Causes and Effects of Climate Change</td></tr>
<tr><td>25</td><td colspan="2">2. My 2050 Simulation</td><td colspan="2">Either Web tool option (a) in ICT suite; OR (b) computer with internet access and a projector / whiteboard</td></tr>
<tr><td></td><td colspan="4">3. Plenary Activities by Subject</td></tr>
<tr><td></td><td>3. A. Citizenship</td><td>3. B. Geography</td><td>3. C. Science</td><td>3.D. Maths</td></tr>
<tr><td rowspan="2">20</td><td>A. Sphere of Influence

(i) Influencing others</td><td>B. Sphere of Influence

(i) Global implications</td><td>C. Sphere of influence

(i) Individual actions</td><td>D. Statistics challenge

(i) 10,000 My2050 Worlds</td></tr>
<tr><td>OR

A. Where do you stand?

(ii) Value continuum activity</td><td>OR

B. Stakeholder views

(ii) Supply and demand role play</td><td>OR

C. Types of energy

(ii) Energy posters</td><td>OR

D. Number crunching

(ii) My2050 Town</td></tr>
<tr><td>5</td><td colspan="2">Evaluation Activity</td><td colspan="2">Postcard pledges to summarise learning in the session</td></tr>
</table>

2. The My2050 lesson

2.1. Starter Activity: Option (a) or (b) (10 minutes)

1. STARTER OPTION (a): Key-Term Match-Up

This is a short activity to introduce students to key words in the My2050 simulation. It is useful as an introduction to climate change.

Use the cut-out key word and definition cards in the annex.

- Divide the students into teams - team size isn't important, whatever suits your class best.
- Give each team a set of key words.
- Read out the definition of one of the terms.
- One player in each team then races to put their hand in the air holding the correct key word.
- The team with the player to put their hand up in the air fastest gets a point.
- The winning team is the team is the one with the most points after all of the definitions have been read out.

Variation: Give the students a set of key word cards and definition cards and get them to simply match up the key terms and definitions in teams, the team who does this the fastest is the winner. This option may be more suitable for Key Stage 3 students.

OR

You can play this as a class round robin (i.e. students can give their opinions verbally around the room, which means that everyone will get a chance to contribute). This option may be more suitable for Key Stage 4 students.

Differentiation: There are two sets of keywords in the annex – Key Stage 3 cards and Key Stage 4 cards (or lower ability and higher ability).

OR 1. STARTER OPTION (b): Climate Change Causes and Effects

Variation: Students requiring extra support can refer to *1a.Key-Term Match-up* in the annex to guide them. You can also ask students to suggest different locations in the UK and around the world where these causes and effects are taking place.

Differentiation: Students can be asked to rank the causes and effects according to their severity and explain their decisions. Students may also wish to explore the arguments of those who are sceptical about climate change.

This is a short activity to get students to explore the causes and effects of climate change and is more suited to a class that has already examined the issue of climate change.

- Students should create a table divided into two columns with the headings: 'possible causes of climate change' and 'possible effects of climate change', as shown in *1b. The cause and effect table.*
- Students should populate the table based on their prior knowledge of the causes and effects of climate change.
- The facts below may be useful for students.

Climate change facts

- Rising temperatures – the average temperature of the Earth's surface has risen by about 0.8^{o}C since around 1900.
- Global average sea level continues to rise – likely to be 0.5m or more by the end of the century.
- Extreme weather – more frequent heat waves and heavy precipitation are very likely in the coming decades in many regions.
- Increased risk of extinction for 20 to 30% of species and loss of biodiversity.

The My2050 Simulation

Before running a session using the My2050 simulation, it is useful to understand how the simulation works. The My2050 Simulation contains 14 levers, separated into 7 **supply options** and 7 **demand options**. More information can be found about each option by clicking on the name of the lever. It works well to start from the left and move to the right when selecting levers.

In order to reach the target to reduce greenhouse gas emissions by 80% below 1990 levels, you must set the level of ambition you want for each of the 14 levers, from low effort through to high effort. This is shown as levels 1 – 4. As well as reaching the reduction in emissions target, you should aim to **balance the amount of energy you supply with the amount of energy that you demand** so that you achieve **energy security**. This can be explored by clicking on the 'My Energy Security Indicator' bar.

'Top Tips'

- The biofuel production lever must always be set higher than level 1
- The fossil fuels lever needs to be set low, but fossil fuels are still important in ensuring security of supply
- There needs to be effort made in both the supply and demand levers
- Some levers have less impact than others

Key messages

The My2050 Simulator is based on a more complex data set – the 2050 Calculator. You may wish to direct particularly keen students to this online tool: http://2050-calculator-tool.decc.gov.uk/

DECC is using this tool to help understand what needs to be done to ensure emissions targets can be reached while maintaining energy supply. The key messages from the 2050 Calculator and the My2050 simulation are that:

- Ambitious per capita demand is required. The greater the constraints on low energy carbon supply, the greater the reduction in demand will need to be.
- A substantial level of electrification of heating, transport and industry is needed.
- Electricity supply may need to double, and will need to be decarbonised.
- A growing level of variable renewable generation increases the challenge of balancing the grid.
- Sustainable bioenergy is a vital part of the grid in sectors where electrification is unlikely to be practical.
- There is an ongoing need for fossil fuels in our energy mix.
- Emissions from agriculture, waste, industrial processes and international travel make up a small proportion of emissions today, but will have a much greater significance by 2050.

Further information can be found at: www.gov.uk/2050-pathways-analysis

Feedback

The Department of Energy and Climate Change (DECC) is keen to engage in an open and transparent debate around the choice and trade-offs the UK faces to reach the 2050 emissions reduction target. The My2050 world that you choose can be shared on Facebook and Twitter to compare and debate different options. The first 10,000 My2050 worlds that have been submitted online have been analysed by market research group Ipsos MORI and can be downloaded on the DECC website.

2.2. My2050 Simulation: Option (a) or (b)(25 minutes)

Explain to the students that the Department of Energy and Climate Change (DECC) has created a simulation to try and find out what they would do to help meet the UK's target to reduce its greenhouse emissions by 80% below 1990 levels by 2050 as set out in the Climate Change Act 2008.

Option (a) describes what to do if you are using an ICT suite; option (b) describes what to do if you are going to use the whiteboard in the classroom.

2. OPTION (a): Students have access to an ICT suite

1. Ask students to enter http://my2050.decc.gov.uk into the address bar. Students should wait for tool to load (a screenshot is shown on the front page of this toolkit).

2. Students should then click on the blue box (where it asks 'can you reduce our greenhouse emissions by 80% below 1990 levels and help avoid dangerous climate change?'). **Inform students, if they don't already know, that this is a legally-binding target that the UK Government has agreed to in order to tackle climate change**.

3. Read out the statement on the next screen: '**By 2050 we will need to change dramatically the way we produce and consume our energy'**. As students click on the next button, explain that the tool refers to UK generation of energy as supply and our consumption of energy as demand. Instruct students that you are going to give them 10 minutes to come up with the 'best' solution for the UK, by making changes at the level of home, city and country using the levers. Students will have to decide what they understand by 'best solution'.

4. **Variation**: you can extend this activity by getting students to focus on creating an ideal supply world and discuss why they made specific choices, before looking at creating an ideal world in terms of demand – this will add 10 minutes to the activity.

5. Remind students that they can find out more about the individual levers by using the information icon.

6. At the end of the challenge, ask students to stop and, in groups, discuss their solutions:

- What criteria did they use to achieve the ideal solution? (carbon emissions, impact on the economy, level of change required in society)
- Did they need any additional information to make better choices about what the UK should do to achieve this target?
- How many people considered the balance between supply and demand? Why is this important? (N.B. If the UK generates more energy than it needs, then this could be used as export to other countries, thereby helping with the reduction of carbon emissions elsewhere).

7. Once students are happy with their ‘new world’, ask them to submit their world by clicking on the 'submit my world' icon.

Figure 2: An example of a My2050 World

*Image: **http://my2050.decc.gov.uk/***

8. Students should **read the details on the next page and only submit the world if they are happy that their changes are realistic**. Remind them that these are changes that would impact on their lifestyles as they become adults.

Figure 3: Ready to submit a My2050 World

*Image: **http://my2050.decc.gov.uk/***

OR 2. OPTION (b): Access to computer with internet access and a projector/ whiteboard

1. Make sure that the website is already loaded when the class starts – http://my2050.decc.gov.uk/

2. As you click on the blue box (where it asks 'can you reduce our greenhouse gas emissions by 80% below 1990 levels and help avoid dangerous climate change?'), inform students, if they don't already know, that this is **a legally-binding target that the UK Government has agreed to** in order to tackle climate change

3. Read out the statement on the next screen: **'By 2050 we will need to change dramatically the way we produce and consume our energy'**. As you click on the next button, explain that the tool refers to our generation of energy as supply and our consumption of energy as demand.

4. Explain to the students what each lever on the game represents (clicking on the lever will give you more background information on it) and that you can set each lever to 1,2,3 or 4.

5. Read out a lever name and explain what each level (1, 2, 3 and 4) will mean in 2050. For example if the oil, gas and coal power lever is set to level 1, this means that in 2050 we will use 10% of the fossil fuels we use today, if the lever is set to level 2 we will use 50% of the fossil fuels used today and so on.

6. Ask the students to show which level they would put the lever on by lifting their arms to a certain height in front of them. If they think the lever should be on level 1 they should put their arms straight out in front of them, if they think level 2 they should lift their arms slightly higher, level 3 should be higher still and for level 4 the students should have their arms straight, above their heads.

7. Go through all the levers in this way and set the lever to the level the majority of the class vote for.

8. Once students have voted on each of the levers, see if your My2050 world reaches the 80% less emissions target. If it doesn't, ask the students how they would change the levers and then see if the class agree with their ideas.

9. If your world does reach the target, ask students if they would be happy to live in the world they have created. Would they be willing to make the changes indicated? What do they think life would be like in their My2050 world?

2.3. Plenary Activities by Subject (20 minutes)

A. Citizenship

3A. CITIZENSHIP OPTION (i): Sphere of influence - Influencing others

This activity aims to get students to **think about what they can do to influence people, organisations and the government around the 2050 target**. You might want to explore different types of influence with the students (getting friends to go to a film that they might not have wanted to see; persuading parents to participate in a walk to school campaign; national campaigns).

- Give out the sphere of influence sheet *3A (i): Sphere of influence* worksheet.
- Ask students to imagine that they are in the centre of the sheet and the circles show how wide is their area of influence.
- Students should write down the names or groups of people that they are able to affect directly to change their behaviour to help tackle climate change in the UK in the inner circle. This can include friends, family members, their school and people in their local community (e.g. shopkeepers)
- In the outer circle, students should consider people they can influence indirectly (through the people they can directly influence).

Variation: Students can explain how they will influence people in the sphere and what behaviour they will get them to change**.**

Differentiation: Ask students to collect newspaper and magazine cuttings or articles from online sources related to stories about energy and climate change in the media. How does the media influence the public in acting to reduce carbon emissions? How are global events portrayed? e.g. the Fukushima serious nuclear accident in March 2011. This option may be more suitable for Key Stage 4 students.

A. Citizenship

3A. CITIZENSHIP OPTION (ii): Where do you stand?

Variation: Ask students to imagine a line running across the classroom; from strongly agree on one side of the room to strongly disagree on the other. Read out one statement at time from *3A(ii): Where do you stand?* worksheet. Ask students to indicate how they feel about the statement by standing on the line. Ask some students why they have chosen to stand where they are. You can allow students to move once they have heard reasons from their peers.

Differentiation: It is likely that this activity will produce a range of responses and students will have different ideas about what they should do about climate change. Ask students to imagine they work for the Government creating new policies. Given that people often have very different opinions when it comes to climate change, what would they do? How would they create policies that would be accepted by the public? How does this fit with the idea of democracy in society? This is especially suitable for Key Stage 4 students.

- Give out the values continuum sheet to each student *3A(ii): Where do you stand?* sheet.
- Ask students to answer questions honestly.
- If you have time, ask for feedback on some of the statements.

B. Geography

3B. GEOGRAPHY OPTION (i): Sphere of Influence – in the wider world

This option explores the **global implications of students' learning**.

Note: You will need to have loaded this page – *http://bit.ly/hyTPkV* and clicked on 'full screen' before the lesson. You will see CO_2 tonnes per person on the vertical axis and income per person on the horizontal axis.

- Students are going to look at an interactive display of statistics that shows global CO_2 emissions since 1820.
- Explain that the graph shows each country as a bubble. The size of each bubble relates to levels of CO_2 emissions.
- Point out that there are few countries shown in 1820. Ask why? In 1820, the UK leads the world in terms of CO_2 emissions because of the industrial revolution.
- Clicking play displays the progress from 1820 to now. Comment on what you see.
- Industrialised countries are near top right corner with high GDP and high CO_2 emissions. The bottom right has fewer industrialised countries; low GDP and low CO_2.
- Discuss the relationship between CO_2 and development – can students explain why CO_2 emissions are higher in the USA than the Democratic Republic of Congo for example?
- There is an argument that industrialised countries should cut their CO_2 emissions more significantly because they have used up their share of greenhouse gases over the last 200 years – what do students think about this?

This activity would benefit from being extended into homework for further research, but can be a good discussion activity about the global implications of climate change and how we should allocate the world's resources.

Variation: You can run a more limited graph with 7 countries (USA, UK, Germany, Brazil, India, South Africa and Ghana) – www.bit.ly/geJIEz.

Differentiation: You can challenge students to find countries that have the highest and lowest CO_2 emissions. You can also use specific dates to mark key points in history that might have a relevance to climate change issues (e.g. the advent of cars; the Second World War; mass airline travel).

B. Geography

3B. GEOGRAPHY OPTION (ii): Stakeholder views - Supply and demand role play

This option explores the **ways in which people's values and attitudes differ** and may affect **social, environmental, economic** and **political issues.**

- Split the class into groups of 2 or 3 students.
- Give each group an identity as a stakeholder from the *3B(ii) Supply and demand role play* cards in the annex.
- As a group, ask them to imagine themselves as the stakeholder they have been given.
- Students should decide which supply and demand options their stakeholder might choose if they were to play the My2050 simulation.
- Each group should tell the rest of the class the options they have chosen for their stakeholder and why they might choose those options.
- How will different stakeholders choices affect the following:
    - Impact on CO_2 levels;
    - Impact on the UK's economy; and
    - Impact on the lifestyle of people living in the UK?

Variation: Ask students to consider how the different choices that different stakeholders make will affect supply and demand options for UK energy.

Differentiation: The class can ask questions of each stakeholder and suggest problems with their choices, as well as possible solutions in compromising between different choices.

C. Science

3C. SCIENCE OPTION (i): Individual actions

This activity helps students to **identify with their learning as individuals** as well as **place their learning within their school**. Computer access will be useful for extending research activities.

- Divide students into groups or work as a whole class, hand out the *3C(i) individual action cards.*
- Inform students that they will now be given a challenge to peg the actions on the washing line in order of how much energy they think they would save per day from doing them - from the least energy one end to the most energy the other.
- Reveal the correct order to students using the "individual action answers" sheet. Inform the students that the data is only a rough idea and that the actual energy saving would differ from person to person depending on how much energy they used in the first place.
- Ask the students to name the things which they already do.
- The students should then put the cards on the washing line again, this time in order of preference of performing the actions – from the actions they would find more difficult to take at one end down to the actions they would prefer to take at the other. Students may need to research costs of some of the actions e.g. solar panels and double glazing.
- Discuss with the students the problems they would encounter when performing the actions and whether they are feasible. Are there some that they think could be implemented in school? Are there some which would be easier to do than others?

Variation: Students could simply lay the cards out in order rather than pegging them to the line.

Differentiation: To make this more suitable for Key Stage 4 students you can have a discussion on the costs, both financially and socially, of taking different actions. You could also put emphasis on the school and ask students what actions they feel the school should take.

C. Science

3C. SCIENCE OPTION (ii): Energy Posters

The aim of this activity is that students research different energy sources and form opinions about the advantages and disadvantages of each based on their findings. In this activity students will discover the science behind each energy option.

You will need to use the *3C(ii): Energy quotations* in the annex. You will also need internet access for students or books on the energy forms mentioned in the quotations, for the research element of the task.

- Split the students into groups.
- Give each group an opinion card about a type of energy. Each group should have a different quotation.
- Tell the students they are to research their given forms of energy; to find out how they are produced; and create a poster from their findings to show the advantages and disadvantages of that particular energy source.
- Students should focus on the advantages and disadvantages of each energy type.
- Emphasise that the quotations are opinions and not facts and that there is no right or wrong answer.
- After the students have completed their research, ask them to share their findings with the class and whether or not they agree with the quotation they were given. Did their research influence their opinions?

Variation: Students can be split into teams, with each person in the team given a quote. They can research individually and then go back into their groups and present their poster to the group.

Differentiation: Students can prepare a presentation rather than a poster and include diagrams of how their type of energy works. They can then pitch their energy type to the class and receive feedback. This option may be more suitable for Key Stage 4 classes or as an extension activity.

D. Maths

3D. MATHS OPTION (i): Statistics challenge - 10,000 My2050 worlds analysis

This option explores the common themes and messages displayed in the first 10,000 My2050 worlds which have been submitted and involves the students creating graphs using data from these worlds.

Note: You will need to use the *3D(i): 10,000 My2050 Worlds Data Analysis* sheet in the annex and will need 2 sheets of graph paper per student or team.

- Give out the My2050 data sheets and the graph paper. Students should work in groups.
- Explain to the students that the numbers on the sheet represent the average height of each lever in 10,000 My2050 worlds. For example the number next to Bio fuel production is 1.64, this means that on the average level of this lever across the 10,000 My2050 worlds was 1.64.
- Ask the students to take a look at the data and predict any patterns they might find when constructing their graphs.
- Ask the students to create two graphs; one using the demand lever averages the other using the supply lever averages.
- Once the graphs have been drawn, encourage the students to compare the two graphs and discuss the conclusions they draw i.e. the My2050 worlds were more demand orientated than supply.
- Get the students to think about why people have concentrated on demand rather than supply and ask them to look at the differences and similarities between the 10,000 submitted worlds and their own world.

Variation: Ask students to work on their own and then once they have drawn the graphs go round the class and ask each person to say a conclusion they drew or something they noticed about the graphs.

Differentiation: Students can go on to calculate the median and mean for the two sets of data (supply and demand). These can then be plotted on the graphs and compared. Key Stage 4 students can calculate the upper and lower quartiles, inter-quartile range and standard deviation of the data. How reliable is the sample size? Some members of the public submitted more than one world. How does this affect the reliability of the data?

D. Maths

3D. MATHS OPTION (ii): Number crunching - My2050 Town

This option asks the students to become the council of a town who has decided to convert to renewable energy sources. It makes them aware of compromises which are going to have to be made in the future. In the task, students are required to use their mathematical skills to calculate the quantity needed of each energy option (e.g. wind turbines, solar panels) to meet the town's daily energy needs.

Note: You will need to use *3D(ii:) My2050 town stimulus* sheet and the *3D(ii:) My2050 town energy supply* sheet.

- Give out the *3D(ii): My 2050 town stimulus* sheet. This activity is best performed in groups but pupils can work on their own if you prefer.
- Explain to the students that they need to use the sheet to explore different ways of providing the town's energy needs using completely renewable energy options.
- The town requires 87,500 kWh of energy per day and three fifths of the energy should come from renewable sources .
- Students should aim to create a balanced supply and not rely too heavily on one energy source.
- Once students have decided on the combination of energy supply they are going to use, they should fill in the *3D(ii):My2050 town energy supply* sheet.
- Students should then join with another group (or pair up) and discuss their ideas.
- Then ask the students questions such as what would happen to their town if it was a sunless, windless day? How would they overcome this?

Variation: Students can go on to research the costs involved in renewable energy and give an estimate for how much their town will need to spend.

Differentiation: To make this more suitable for higher ability students, ask students to imagine that the council's budget has been cut but they remain committed to renewable energy. With this new budget, how would the energy choices they make be affected? Students will have to change their original choices.

2.4. Evaluation (5 minutes)

SUMMARY OF LEARNING: I pledge to…

- Give out a post card to each student (*Pledge postcard template in the annex.)*
- Ask students to write 3 pledges that they will do to support the UK's target to reduce its CO2 emissions. These could be as an individual, at home, in the school or in the local community.
- Students should sign their names on the pledge cards – they can be displayed in the classroom at the end of the lesson.

3. Websites with further resources

www.gov.uk/2050-pathways-analysis – more information on the My2050 project, and access to the Excel-based 2050 Calculator that allows you to explore your pathway in greater depth.

www.globalcalculator.org – a worldwide version of the UK's 2050 Calculator that helps you to understand the link between our lifestyles, the energy we use, and the consequences for our climate. Includes videos, presentations and speaking notes to help you present it.

www.cat.org.uk – the Centre for Alternative Technology offers solutions for sustainable living in the UK.

www.decc.gov.uk – The Department of Energy & Climate Change (DECC) works to make sure the UK has secure, clean, affordable energy supplies and promote international action to mitigate climate change.

www.energysavingtrust.org.uk – a non-profit organisation set up to address the effects of climate change by encouraging individuals and businesses to use energy effectively.

www.foe.co.uk – an international network of grassroots environmental groups seeking to lobby governments.

www.globaldimension.org.uk – a guide to books, films, posters and web resources which support global, intercultural and environmental understanding for all age groups and subjects. From climate change to poverty, water to fair trade, you can find a huge range of teaching resources and background material.

www.greenpeace.org.uk – UK branch of the international environmental activist network.

www.iied.org – an independent, non-profit organization promoting sustainable patterns of world development through collaborative research, policy studies and networking.

www.ipcc.ch – the Intergovernmental Panel on Climate Change was been established by the United Nations to provide rigorous and balanced scientific information about changes in the world's climate. Its site features detailed reports, diagrams and resources including a comprehensive report on climate change conducted in 2007.

www.metoffice.gov.uk – this site, which is partially Government funded, contains detailed weather and climate change analysis.

www.think-global.org.uk – an education charity that promotes global learning.

www.ukcip.org.uk – a Government funded site looking at the potential environmental and economic impacts of climate change in the UK.

4. Optional extra activities for the whole school

Activities included in this section are ideas to help extend the learning from this lesson to your wider school community.

Poster competition

Students can create posters to raise awareness of the 2050 targets and put them around school. This could be run as a poster competition within a year group, or as a starter activity that leads to a school assembly.

School Assembly

Ask students to prepare a short assembly which tells other students about the 2050 target and invites them to think about how one can help the UK to meet it. You may want to consider getting an expert in from a relevant local organisation to support the students.

Work with your local primary school

Older students can create a short activity to be used in your feeder primary schools. The aim would be to get students to explain what they have learned to younger students and get them involved in the debate.

School debate

Students can organise a series of debates (during a drop down day, for example) to explore the issue of climate change and what the UK should look like in 2050. You can use the role play cards *2a: Supply and demand role play cards* to ensure that teams approach the issue from different perspectives.

Creating a film

If your school has a media lab, you can encourage students to create a film that can be shown at assembly about the impact the 2050 target will have on their lives and the life of their community. This could be a great community project that your school could use to bring it parents and wider members of the local community.

Science fair

Students can be challenged to create their own renewable source of energy and all the entries can be part of a science fair that showcases ideas for creating a smaller carbon footprint either by tackling issues of supply (i.e. designing renewable energies) or issues of demand (i.e. imaging solutions to carbon heavy activities).

Maths day

Students can be asked to look at different aspects of the 2050 Calculator (listed on the DECC websites page). Teachers will be able to set a range of numerical challenges for students about the figures.

Produced by:

www.think-global.org.uk

www.involve.org.uk

www.ipsos-mori.com

www.decc.gov.uk

Annex: Supplementary Materials for Lesson Activities

1a: Cards for Key word match-up game ✂

BIOFUELS	Fuels made from organic materials such as wood and straw.
NUCLEAR ENERGY	A process called nuclear fission is used to create heat energy which heats water and makes steam. The steam causes turbines to rotate which is used to generate electricity.
WIND TURBINES	Convert wind energy to electricity for distribution.
SOLAR PANELS	Contain photovoltaic (PV) cells that convert sunlight into electricity.
HYDROPOWER	Converting the energy from moving or falling water into electricity.
MARINE POWER	Harnessing energy from the movement of waves and turning it into electricity.
COAL POWER PLANT	Coal is crushed and then burnt. This energy heats water and creates steam. The steam causes turbines to rotate which is used to generate electricity.
CLEAN GAS, COAL AND OIL POWER	A new technology for reducing emissions. When carbon is emitted it is captured and stored underground to stop it from going into the atmosphere.
SUSTAINABLE DEVELOPMENT	Development that meets the needs of the present without reducing the ability of future generations to meet their own needs
GREENHOUSE EFFECT	Carbon dioxide and other gases trap infra-red radiation in the atmosphere leading to increased temperatures and changes to climate.
CLIMATE CHANGE	Long term changes in weather patterns on a global scale.

EMISSIONS	Greenhouse gases released into the atmosphere.
RENEWABLE ENERGY	Energy from natural sources such as sunlight, wind, rain, tide and geothermal heat. There is an infinite supply of these resources.
FOSSIL FUELS	Coal, oil and natural gas. Fuels produced from the remains of plants and animals that lived millions of years ago. There is a finite supply of these resources.
PHOTOSYNTHESIS	The process by which plants use sunlight to manufacture carbohydrates from water and carbon dioxide in the atmosphere.
CARBON SINK	Anything which absorbs more carbon than it releases.
CLIMATE CHANGE MITIGATION	Reducing the sources of greenhouse gas emissions and increasing the number of carbon sinks.
CARBON OFFSETTING	A reduction in emissions of carbon to compensate for emissions released elsewhere.
CARBON CREDITS	The "currency" used in carbon trading which allows a country or organisation to buy and emit a set amount of carbon dioxide.
GREEN ECONOMY	An economy based on sustainable development. This model places an economic value on natural capital (e.g. natural ecosystems) and environmental services to human beings.
CLIMATE CHANGE ADAPTATION	Means of addressing potential impacts and opportunities from changes in climate.

Key Stage 3 cut off.

1b: The cause and effect table

Complete this worksheet by listing at least 4 possible causes and effects of climate change - you should think about your local area as well as the wider world. An example is given:

Causes of climate change

1.

e.g.

Deforestation - reduces the amount of carbon dioxide absorbed through photosynthesis and leads to increased levels of carbon in the atmosphere.

2.

3.

4.

Effects of climate change:

1.

e.g.

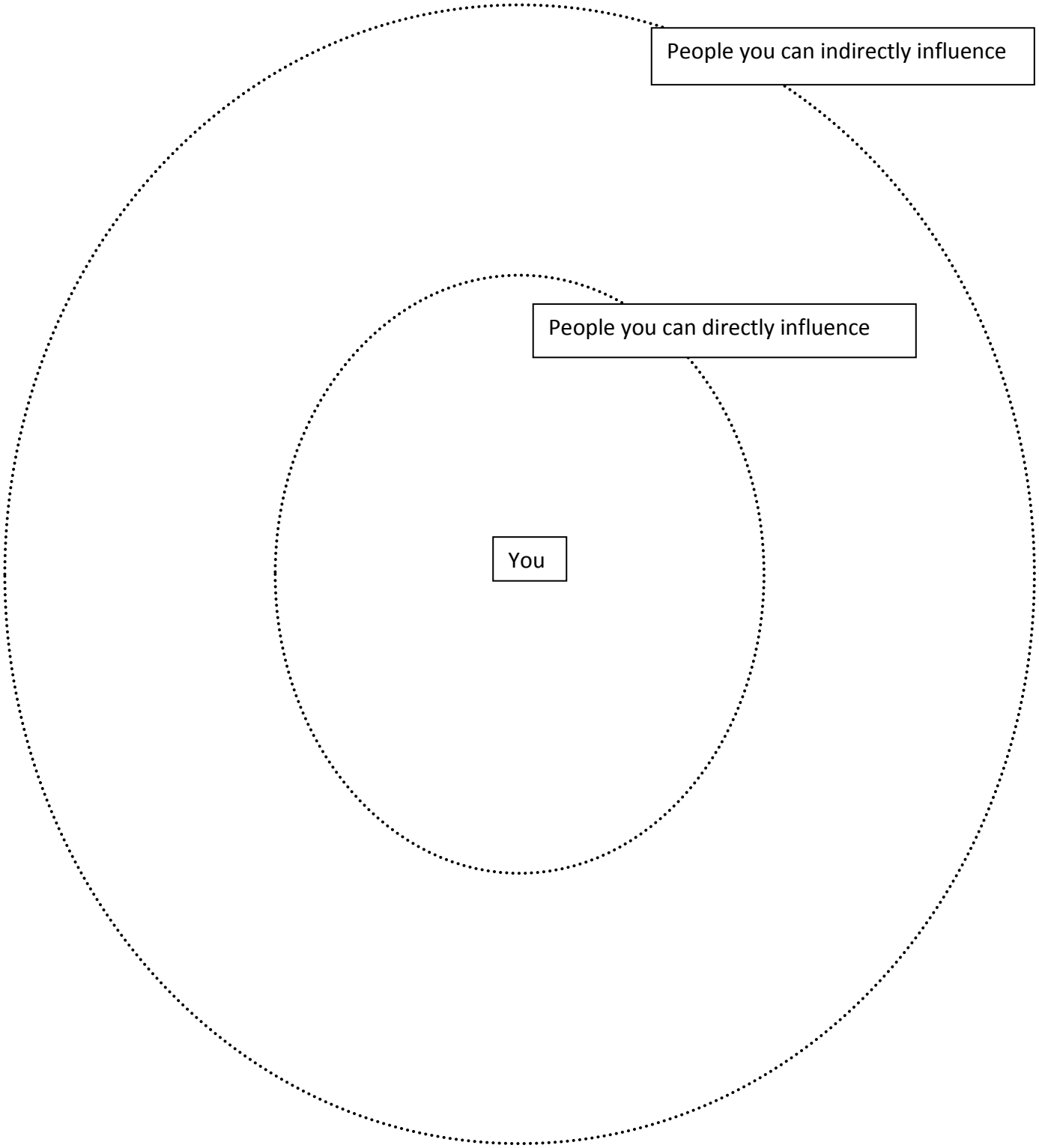
Increased occurrences of extreme weather events, such as heat waves and heavy precipitation.

2.

3.

4.

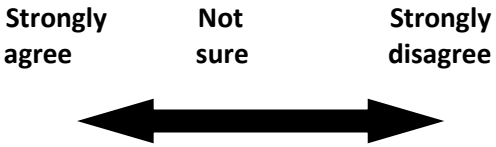
3A (i): Sphere of influence worksheet



3A(ii): Where do you stand?

How much do you agree or disagree?

Read through the statements and mark your view on the scale. Be ready to justify your decision!



There is nothing we can do to tackle climate change	
Everyone should have to change their lifestyle to tackle climate change	
People reducing their energy demand is more effective than developing environmentally friendly forms of energy generation	
We should build more nuclear power stations to tackle climate change	
The UK Government should set a higher target for the reduction of emissions	
The Government should invest in 'green technology' (technology that uses less energy for everyday activities e.g. electric cars)	

3B(ii): Supply and demand role play cards

✂

Car manufacturer

"Cars are the backbone of our economy – we need them to take children to school, to get ourselves to work and to deliver food and other essential things to shops. We can't live without them – that is a fact. I understand that we all have to do our bit to tackle global warming but we also have to be practical – we still have to live!"

Economic expert

"The economy is very sensitive and we need to think about the impact the reduction of CO_2 *emissions is going to have on business. Businesses will be called on to become 'greener' which typically means using more expensive products in order to meet Government targets. We have to be mindful that companies will leave the UK if they feel that there are too many restrictions on their ability to make profits – they will move to countries like India, Brazil and China (who are not bound by the same targets as the UK). Therefore, jobs will be lost."*

Green campaigner

"We only have one world – we can't move somewhere else if we mess this up! The science is clear, we have to do something today – we need to change the way we get energy, move from old polluting forms like coal power stations to more renewable energy like solar and wind but we also have to use less energy. Some of the changes will be small – like turning down our heating by a few degrees and turning our TV off standby but some will be big – reducing the amount of international travel, getting rid of our cars – there is no way to achieve a sustainable planet without doing this!"

Nuclear engineer

"A few wind farms dotted around the countryside or people taking the bus instead of driving is not going to solve the problem of global warming. We need power and lots of it. The world is growing and economies like China and India are growing and need power to lift themselves out of poverty. Nuclear power is the only answer. It produces no carbon dioxide and it is safe"

Farmer

"I am a farmer because I am passionate about growing food but all this talk about climate change and using farm land to grow bio fuels doesn't make any sense to me! All that's going to happen is that we will end up with less food for people and it will ultimately make food more expensive – how does that tackle climate change?"

3C(i): Individual actions answers

Least energy saved

Most energy saved

Action	Possible Saving (per day)
Wash laundry in cold water	1kWh
Stop using a tumble-dryer	1.5kWh
Change lights to a more efficient bulb	4kWh
Use old appliances for longer and don't replace them e.g. computers	4kWh
Reduce draughts in your house	5kWh
Install solar hot water panels	4kWh
Eat vegetarian food 6 days a week	7kWh
Insulate lofts and walls	17kWh
Make fewer car journeys	20kWh
Stop flying	35kWh

N.B. These figures are an approximate indication of the savings of each action. The actual savings depend on the starting point of the consumer. These numbers assume that the starting point is an above-average consumer.

3C(i): Individual actions cards

Wash laundry in cold water

Make fewer car journeys

Insulate lofts and walls

Reduce draughts in your house

Stop using a tumble-dryer

Change lights to more efficient bulbs

Don’t replace appliances unless broken

Install solar hot water panels

Stop flying

Eat vegetarian food 6 days per week

3C(ii): Energy Quotations

Remember, these quotations are opinions that you might hear put forward. They are not necessarily facts.

✂

“ Nuclear energy produces waste that is harmful to humans. If we are not careful with it we could all be killed. Just look at the situation in Japan!”

“Wind turbines don’t even produce much energy and are very expensive. What is the point?”

“Marine power is very dangerous for marine life. Many sea creatures are badly injured or even killed by the rotating turbines.”

“Coal power stations produce so much energy at low cost. Other energy sources will cost more and make it more difficult for poorer people to afford.”

“It isn’t sunny enough in the UK for solar panels, we might as well not bother.”

“There is plenty of countryside in the UK, growing bio crops on a percentage of it will not matter, we will still have lots of land left.”

3D(i): 10,000 My2050 Worlds Data Analysis

Demand	
Lever	**Lever height/ setting**
Manufacturing Growth	1.75
Business Greenness	2.42
Home Efficiency	2.39
Home Temperature	1.37
Heating Fuel	2.17
How We Travel	1.98
Transport Fuel	2.11
Supply	
Lever	**Lever height/ setting**
Bio fuel Production	1.64
Oil, Gas and Coal Power	0.91
Nuclear	1.17
Clean Oil, Gas and Coal Power	1.20
Wind Turbines on Land	1.48
Wind Turbines on Sea	1.84
Solar, Marine and Hydro Power	1.78

3D(ii): My2050 town stimulus

It is the year 2025 and you are a member of a town council on the Western coast of the UK of a population 700. In preparation for 2050, your council has recently decided that the town will source two fifths of its energy from coal power plants and the other three fifths from renewable sources.

Below is a breakdown of how much energy that a range of renewable sources produce and your town's energy requirements (per day). Your task is to decide how much of your energy demand each of these renewable energy sources should supply. Your total energy MUST add up to three fifths of your 87,500kWh's per day energy needs. You can go slightly over your target but you must make sure you are not under.

Try not to rely too heavily on a single renewable source. You have free reign and can build however many turbines and use as much land for other renewable sources as you wish, but think about the implications your decisions are going to have on your town and its people.

Your town requires **87,500 kWh** of electricity per day. **Three fifths** of this must be provided by renewable energy sources.
• **1m²** of land dedicated to off shore wind turbines produces **0.08kWh of electricity** per day
• **1m²** solar panel produces **0.4kWh of electricity** per day
• **1m** of coastline dedicated to marine (wave) power produces **0.2kWh of electricity** per day
• **1m²** of land dedicated to hydropower produces **0.3kWh of electricity** per day
• **1m²** of land dedicated to on shore wind turbines produces **0.05kWh of electricity** per day

Q. How are you going to fulfil your town's energy needs? Decide how many of each renewable source you are going to use to reach the target and then fill in the *My2050 town energy supply* slip.

Q. Do you think your choices are feasible?

Q. The data used in this activity is based on averages, so may not be true to real life in your town. How could this affect the output of energy?

3D(ii): My2050 town energy supply

My2050 town is going to have

__________m^2 of sea dedicated to off shore wind turbines, which will produce _________ kWh per day

__________m^2 of land dedicated to on shore wind turbines, which will produce _________ kWh per day

___________ m^2 of sea dedicated to marine power, which will produce _________kWh per day

___________m^2 of hydropower, which will produce __________ kWh per day

___________m^2 solar panels, which will produce ____________kWh per day

Total of all energy generated by renewable is ____________ kWh per day

My2050 town is going to have

__________m^2 of sea dedicated to off shore wind turbines, which will produce _________ kWh per day

__________m^2 of land dedicated to on shore wind turbines, which will produce _________ kWh per day

___________ m^2 of sea dedicated to marine power, which will produce _________kWh per day

___________m^2 of hydropower, which will produce __________ kWh per day

___________m^2 solar panels, which will produce ____________kWh per day

Total of all energy generated by renewable is ____________ kWh per day

My2050 town is going to have

__________m^2 of sea dedicated to off shore wind turbines, which will produce _________ kWh per day

__________m^2 of land dedicated to on shore wind turbines, which will produce _________ kWh per day

___________ m^2 of sea dedicated to marine power, which will produce _________kWh per day

___________m^2 of hydropower, which will produce __________ kWh per day

___________m^2 solar panels, which will produce ____________kWh per day

Total of all energy generated by renewable is ____________ kWh per day

✂4: Pledge postcard template

I Pledge to... **1.** **2.** **3.**	**I Pledge to...** **1.** **2.** **3.**
I Pledge to... **1.** **2.** **3.**	**I Pledge to...** **1.** **2.** **3.**
I Pledge to... **1.** **2.** **3.**	**I Pledge to...** **1.** **2.** **3.**
I Pledge to... **1.** **2.** **3.**	**I Pledge to...** **1.** **2.** **3.**