

UNIT 6: Global Warming

This unit is comprised of 6 activities which are outlined in table 6.1. These activities have been informed by the ENERGE Energy Literacy Framework. A guide to the ENERGE Energy Literacy Framework can be found in UNIT 0. This unit explores the following topics: the greenhouse effect, global warming, climate change, the global energy systems and the emission of green-house gases as a result of large-scale industrial and human activity. In activities 6.2, 6.3 and 6.4 students mapping out their relationship with fossil fuels, analyse scientific data and form coherent arguments about global warming, climate change and the global energy crisis. In activities 6.1, 6.5 and 6.6 students reflect on the role of Governments and the global energy industry as agents and opponents of change. Students consider the interplay between components of global energy systems and consider the implications for the wider global community. Students will engage in self-reflected learning, systems thinking, innovation and creativity and through developing their data analysis design, critical thinking, communication and collaborative skills. Ultimately, students can better understand their role within the global energy system, explore avenues for collective action, explore ideas that link climate issues to social justice helping students to foster a greater sense of solidarity with people in their own community and on a global level. The activities in this unit are suitable for lower and upper second level students. The energy literacy outcomes, the associated skills & competencies addressed and how the activities link to the national curricula are outlined in tables 5.1-5.3.

OVERVIEW of UNIT 6 Global Warming

Table 6.1 Activities and titles are given, the time required to complete the activity and the ISCED classification.

	Activity Title	Estimated time (min)	Level	
			ISCED 2	ISCED 3
Activity 6.1	Global Energy: What's the story?	15-20	X	X
Activity 6.2	How I depend on fossil fuels (mind-map)	20-30	X	X
Activity 6.3	Global Warming 1: Interpreting the evidence	45-60	X	
Activity 6.4	Global Warming 2: Forming scientific arguments	45-60	X	
Activity 6.5	Human Stories from the Climate Crisis: Role-play	45-60	X	X
Activity 6.6	En-Roads: Climate Simulation (role-play game)	90-120		X

Activity 6.1 Global Energy - What is the Story?

In this short fill-in-the blanks activity, students are encouraged to apply their knowledge about global energy resources to complete a series of factual statements about fossil fuels, renewable energy and the current status and predicted trajectory for the global energy system. Students also use global energy supply data to help them answer the questions. This activity has been developed by St Mark's High School in Warrenpoint, Co. Down, Northern Ireland.

Duration	
<ul style="list-style-type: none"> 15-20 minutes 	
Energy Literacy Characteristics addressed:	
C1	Grounded understanding of science and how energy is harnessed and used to power human activity
C2	Understands the impact that energy production and consumption have on all spheres of our environment and society
C3	Sensitive to the need for energy conservation and the need to develop alternatives to fossil fuel-based energy resources
Skills & Competencies addressed:	
<ul style="list-style-type: none"> Critical Thinking Data Analysis 	
Subject links in National Curricula:	
<ul style="list-style-type: none"> Geography Science Technology & Informatics 	<ul style="list-style-type: none"> Social & Health Civics & Politics Engineering Home Economics
Level	
<ul style="list-style-type: none"> ISCED 2 ISCED 3 	

Suggestions for use:

- This activity is intended to be incorporated into the second-level geography curriculum.

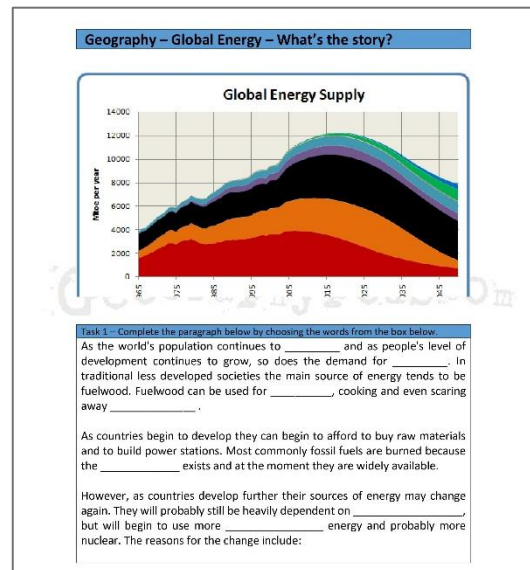


Fig. 1 Activity 6.1 Student Worksheet

- Greater concern for the _____
- Rising _____ of fossil fuels
- The knowledge that fossil fuels are _____
- Aim to reduce reliance on fossil fuel exporting countries
- Improvements in renewable technology
- The hope of developing and selling renewable technology
- Better technology and increased stability allowing _____ development

There are always some exceptions to the rule. For example Costa Rica gets the majority of its power from renewable sources and countries like Lithuania and France get nearly all of theirs from nuclear.

fossil fuels, energy, nuclear, environment, renewable, heating, prices, finite, technology, grow, wild animals

Key Words for this unit of work

Non-renewable energy: Energy that cannot be reproduced in the time that it takes to consume it e.g. coal.

Renewable energy: Energy that is naturally occurring and potentially infinite.

Fossil fuels: Any combustible organic matter that is made from the remains of former flora and fauna.

Raw material: Any unprocessed material.

Fig. 2 Activity 6.1 Student Worksheet

Extensions to Activity

Teachers can expand on this activity if they wish to do so using their own resources or the resources listed below.

- electricityMap.org is a live visualization of where your country's electricity comes from and how much CO₂ was emitted to produce it.
- Carbonmap.org is a tool for visualising the cause and effects of carbon emissions on global regions.

Materials

- [Activity 6.1 Student Worksheet](#)

Activity 6.2 How I depend on fossil fuels (mind-map)

In this activity, students explore their everyday relationship with fossil-fuels and their role within the global energy system by constructing mind maps. Mind mapping encourages students to think critically and can help them to make new connections between ideas. This activity was developed by St Mark's High School in Warrenpoint, Co. Down, Northern Ireland.

Duration	
<ul style="list-style-type: none"> 20-30 minutes 	
Energy Literacy Characteristics addressed:	
C2	Understands the impact that energy production and consumption have on all spheres of our environment and society
C3	Sensitive to the need for energy conservation and the need to develop alternatives to fossil fuel-based energy resources
C4	Cognisant of the impact of personal energy-related decisions and actions on the global community
Skills & Competencies addressed:	
<ul style="list-style-type: none"> Critical Thinking Data Analysis Communicate 	
Subject links in National Curricula:	
<ul style="list-style-type: none"> Geography Social & Health Science Civics & Politics Technology & Informatics Engineering Home Economics 	
Level	
<ul style="list-style-type: none"> ISCED 2 ISCED 3 	

Suggestions for Use

- Teachers can advise students to using the online mind mapping tools included in this activity if computers and internet access are available.

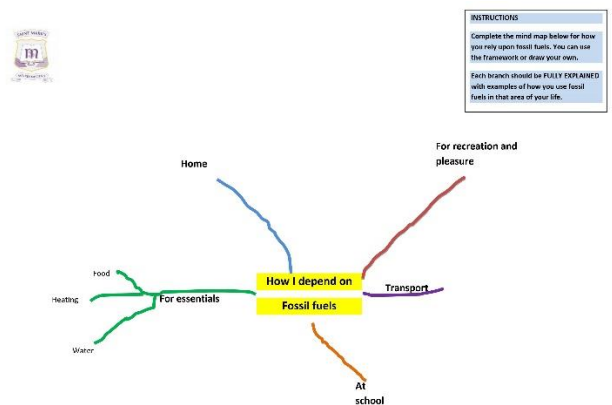


Fig. 3 Activity 6.2 Student Worksheet

Extensions to Activity

Materials

- [Activity 6.2 Student Worksheet](#)
- Miro.com** is a quick and easy, free way for teams to capture, organize, and structure their ideas. Available at <https://miro.com/mind-map/>
- Coggle.it** is a tool for making mindmaps and collaborating with others. Produce beautiful notes quickly and easily. Share them with friends and colleagues to work on your ideas together. Available at <https://coggle.it/>

Activity 6.3 Global Warming 1: Interpreting Evidence

In this activity, students are provided with information regarding the greenhouse effect, and the concept of global warming is introduced. They are then provided with scientific data, and asked to interpret the data to provide evidence that can support or disprove the hypothesis that the increase in the mean temperature of Earth's atmosphere is caused by the increased emission of carbon dioxide. This activity develops students' skill in forming coherent arguments, while also increasing their scientific literacy by encouraging critical thinking.

Duration

- 45-60 minutes

Energy Literacy Characteristics addressed:

C1	Grounded understanding of science and how energy is harnessed and used to power human activity
C2	Understands the impact that energy production and consumption have on all spheres of our environment and society
C3	Sensitive to the need for energy conservation and the need to develop alternatives to fossil fuel-based energy resources
C4	Cognisant of the impact of personal energy-related decisions and actions on the global community

Skills & Competencies addressed:

- Problem Solving
- Research
- Critical Thinking
- Data Analysis
- Collaborating
- Communicating

Subject links in National Curricula:

- Science
- Technology & Informatic
- Engineering
- Geography
- Civics & Politics
- English

Level

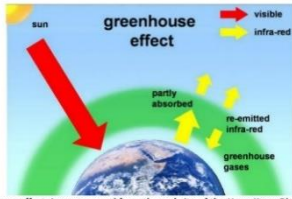
- ISCED 2
- ISCED 3

Suggestions for Use

1. The lesson starts with an introduction to the greenhouse effect and global warming. A whole-class debate or small group discussion can be used as a warm-up activity to review prior knowledge and preconceptions. Copies of this handout can be given to students.

The Greenhouse Effect: Fact or fiction?

Living things need energy to survive. The energy that sustains life on the Earth comes from the Sun, which radiates energy into space because it is so hot. A tiny proportion of this energy reaches the Earth. The Earth's atmosphere acts like a protective blanket over the surface of our planet, preventing the variations in temperature that would exist in an airless world. Most of the radiated energy from the Sun passes through the Earth's atmosphere. The Earth absorbs some of this energy, and some is reflected back from the Earth's surface. Part of this reflected energy is absorbed by the atmosphere. As a result of this the average temperature above the Earth's surface is higher than it would be if there was no atmosphere. The Earth's atmosphere has the same effect as a greenhouse, hence the term *greenhouse effect* (see image below).



Greenhouse effect. Image sourced from the website of the Hong Kong Observatory:
http://www.hko.gov.hk/climate_change/faq/faq_e.htm#Q4

The greenhouse effect is said to have become more pronounced during the twentieth century and the first part of the twenty-first century. It is a fact that the average temperature of Earth's atmosphere has increased. In newspapers and periodicals the increased carbon dioxide emission is often stated as the main source of the temperature rise in the twentieth century.

Fig 4. Activity 6.3 Student Worksheet

2. Students are then asked to consider two graphs, one detailing carbon emissions since the Industrial Revolution and the other showing mean global temperature over the same time period. A student handout or worksheet is proposed for this activity.
3. The students are given asked to consider the statement "From these two graphs, student A draws the conclusion that it is certain that the increase in mean temperature in Earth's atmosphere is caused by the increased emission of carbon dioxide." Students are asked to form arguments in support of Student A, using evidence from the graphs.

Activity A: Interpreting the evidence

Based on "Greenhouse," by the OECD, *Take the Test Sample Questions from OECD's PISA Assessments*, <http://www.oecd.org/pisa/pisaproducts/take%20the%20test%20sample%20questions%20book.pdf>, 2009.

Student A is interested in the possible relationship between the average temperature of the Earth's atmosphere and the carbon dioxide emission on the Earth. When searching for information, he finds the following two graphs.

Graphs showing emission of carbon dioxide and mean global temperature from 1860 to 1995.

From these two graphs, student A draws the conclusion that it is certain that the increase in the average temperature of the Earth's atmosphere is due to the increase in the carbon dioxide emission.

Task 1. Where in the graphs can support be found for the conclusion made by Student A that the increase in mean temperature in Earth's atmosphere is caused by the increased emission of carbon dioxide? Give supportive arguments for this conclusion with reference to the graphs. Use the rubric to check your answer.

Task 2. Another student, Student B, thinks that the conclusion by Student A is wrong. She compares the graphs and claims that some parts of the graphs do not support the conclusion that the increase in mean temperature in Earth's atmosphere is caused by the increased emission of carbon dioxide. Identify the parts of the graphs that do not support the conclusion by Student A and present supportive arguments for the conclusion made by Student B. Use the rubric to check your answer.

Fig. 5. Activity 6.3 Student Worksheet

- In task 2, students are asked to consider the conclusions drawn by Student B, who thinks that the conclusion by Student A is wrong (Figure 2). Student B compares the graphs and claims that some parts of the graphs do not support the conclusion that the increase in mean temperature in Earth's atmosphere is caused by the increased emission of carbon dioxide.
- Students are then asked to form arguments in support of Student B, again using evidence from the graphs.

Extensions to Activity 6.3

- After completion of the tasks, students can engage in peer or self-assessment. Rubrics are provided, which detail the criteria for assessing scientific information. See rubric in fig. 6.

Skills Assessed	Level 1	Level 2	Level 3
Using scientific knowledge	Makes reference to both graphs (as a whole).	Makes reference to both graphs (as a whole and in detail).	Makes reference to both graphs (as a whole and in detail).
	Presents supportive arguments for at least one of the student's conclusions.	Presents supportive arguments for at least one of the student's conclusions.	Presents supportive arguments for at least one of the student's conclusions.
	Attempts to provide scientifically reasonable justifications for arguments.	Provides scientifically reasonable justifications for arguments.	Provides scientifically valid justifications for arguments.

Fig. 6. Activity 6.3 Peer Assessment Rubric

Materials

- [Activity 6.3 Student Handout](#)
- [Activity 6.3 Rubric](#)

Activity 6.4 Global Warming 2: Interpreting Evidence

In this activity, the students read a quote from Governor Rick Perry, from a press conference when Perry described his doubts about global warming. Students are asked to evaluate the quote and distinguish the parts that are scientific evidence and those that are opinion. In this way, they can develop their skills of critical thinking and evaluating evidence to form their own opinions.

Duration	
<ul style="list-style-type: none"> 45-60 minutes 	
Energy Literacy Characteristics addressed:	
C1	Grounded understanding of science and how energy is harnessed and used to power human activity
C2	Understands the impact that energy production and consumption have on all spheres of our environment and society
C3	Sensitive to the need for energy conservation and the need to develop alternatives to fossil fuel-based energy resources
C4	Cognisant of the impact of personal energy-related decisions and actions on the global community
Skills & Competencies addressed:	
<ul style="list-style-type: none"> Problem Solving Research Critical Thinking 	<ul style="list-style-type: none"> Data Analysis Collaborating Communicating
Subject links in National Curricula:	
<ul style="list-style-type: none"> Science Technology & Informatic Engineering 	<ul style="list-style-type: none"> Geography Civics & Politics English
Level	
<ul style="list-style-type: none"> ISCED 2 ISCED 3 	

Suggestions for Use

- The students are asked to carefully review the quotation from Governor Rick Perry.
- The teacher asks the students, "How would you argue against the argument made by Rick Perry?"
- Students are asked to write their response, presenting their arguments, which should be based on their knowledge of global warming, the carbon cycle and other scientific methods.
- The teacher can prompt the students, by asking them to consider the types of argument used by Governor Perry, "Which arguments are based on facts and which are based on opinions and values?"

Part B: Forming scientific arguments

Rick Perry is a governor in Texas and was one of the republican candidates for the US election in 2002. The quote below comes from a press conference, when Perry described his doubts about global warming.

"I do believe that the issue of global warming has been politicised. I think there are a substantial number of scientists who have manipulated data so that they will have dollars rolling into their projects. I think we're seeing it almost weekly or even daily, scientists who are coming forward and questioning the original idea that man-made global warming is what is causing the climate to change. Yes, our climates change. They've been changing ever since the earth was formed. /.../ The science is not settled on this. The idea that we would put Americans' economy at jeopardy based on scientific theory that's not settled yet to me is just nonsense."

How would you argue against the argument made by Rick Perry?

Write a text where you use your knowledge about global warming, the carbon cycle, scientific methods, etc. Think about what kind of arguments Perry makes use of – which are based on facts and which are based on values and opinions?

Do not forget to provide scientific justifications for your arguments. Adapt your text in order to convince supporters of Perry's argument. Use the rubric to check your answer.

Fig. 7 Activity 6.4 Student Handout

Extensions to Activity 6.3

5. After completion of the tasks, students can engage in peer or self-assessment. Rubrics are provided, which detail the criteria for assessing scientific information. See rubric in fig. 6.

Skills Assessed	Level 1	Level 2	Level 3
Analysing Arguments	Identifies any of Perry's	Justifies whether a selected argument made by Perry is based on opinions and/or scientific facts.	Identifies whether Perry's arguments are based on opinions and/or scientific facts.
Providing Counter arguments	Provides a counter argument to any of Perry's arguments.	Provides counter argument to more than one of Perry's arguments.	Provides counter argument to Perry's arguments
Justifying arguments	Bases own arguments on opinions and/or scientific facts.	Bases own arguments on scientific facts	Bases own arguments on scientific facts
Using scientific knowledge	Attempts to use scientific concepts, models, and theories for supporting arguments	Uses scientific concepts, models, and theories for supporting arguments.	Uses relevant scientific concepts, models, and theories in a correct way for supporting arguments.

Fig. 8 Activity 6.4 Peer Assessment Rubric

Materials

- [Activity 6.4 Student Handout](#)
- Activity 6.4 Assessment Rubric

Activity 6.5 Human Stories from the Climate Crisis (Role-play)

This activity has been developed by the Zinn Education Project. This organisation based in the USA that is coordinated by two non-profit organizations, Rethinking Schools and Teaching for Change that have spent decades developing and providing social justice resources for teachers. The ENERGE Project has been granted permission to provide a direct link to this resource. The following activity description has been provided:

“Through role play, the Climate Change Mixer introduces students to 22 individuals around the world—each of whom is affected differently by climate change. For some, climate change threatens to force them to leave their land. For others, it is a business opportunity. In this activity, students meet one another in character and learn about the impact of climate change in their lives—and how each is responding.”

Duration	
• 45-60 minutes	
Energy Literacy Characteristics addressed:	
C2	Understands the impact that energy production and consumption have on all spheres of our environment and society
C3	Sensitive to the need for energy conservation and the need to develop alternatives to fossil fuel-based energy resources
C4	Cognisant of the impact of personal energy-related decisions and actions on the global community
Skills & Competencies addressed:	
• Research	• Collaborating
• Critical Thinking	• Communicating
Subject links in National Curricula:	
• Science	• Civics & Politics
• Social & Health	• English
• Geography	
Level	
• ISCED 2	
• ISCED 3	

Suggestions for use:

1. Instructions for carrying out this activity including questions for a follow up discussion can be found by visiting the link included in this document and downloading the materials.
2. Learn more about the aims of the Zinn Education Project Organisation at this site: www.zinnproject.org

Extensions to Activity 6.5

A People’s Curriculum for the Earth offers dozens more lessons for teaching about climate change. Find additional resources for the classroom on the environment below. Available at:

<https://rethinkingschools.org/wp-content/uploads/2020/07/Climate-Justice-Seed-Kit-APCE-Preview.pdf>

Materials

This activity is available at the following link: <https://www.zinnedproject.org/materials/climate-crisis-mixer>

Activity 6.6 En-ROADS Climate Change Solutions Simulator

In this activity, students can see how the policy choices interact with each other, and how they affect a variety of climate variables from temperature change to sea level rise. The En-ROADS Climate Change Solutions Simulator is a tool for measuring the impacts of policy choices on climate. En-ROADS instantly shows the results of hypothetical changes to a large number of variables such as energy, land use, transportation, carbon removal, population growth and economic policies. The En-ROADS guided assignment challenges participants to use the En-ROADS simulator to create a scenario that successfully addresses climate change while considering implications across the economy, environment, and society.

Duration	
<ul style="list-style-type: none">90-120 minutes	
Energy Literacy Characteristics addressed:	
C2	Understands the impact that energy production and consumption have on all spheres of our environment and society
C3	Sensitive to the need for energy conservation and the need to develop alternatives to fossil fuel-based energy resources
C4	Cognisant of the impact of personal energy-related decisions and actions on the global community
C5	Strives to make choices and decisions that reflect these attitudes with respect to energy resource development and energy consumption
Skills & Competencies addressed:	
<ul style="list-style-type: none">ResearchCritical Thinking	<ul style="list-style-type: none">CollaboratingCommunicating
Subject links in National Curricula:	
<ul style="list-style-type: none">ScienceSocial & HealthGeography	<ul style="list-style-type: none">Civics & PoliticsEnglish
Level	
<ul style="list-style-type: none">ISCED 2ISCED 3	

Suggestions for use:

Teacher should visit the following website:

<https://www.climateinteractive.org/tools/guided-assignment/>

1. Teachers should read the educators guide available via the website prior to carrying out this activity.
2. Teachers can download the assignment document (Short version). This document should be given to the students.
3. Teachers can also access the En-ROADS User Guide which explains use of the simulation tool.
4. Climateinteractive.org also provides an interactive support desk:

<https://support.climateinteractive.org/support/home>

Extensions to Activity

Materials

- [Activity 6.6 Student Assignment \(word\)](#)
- [Activity 6.6 Student Assignment \(pdf\)](#)

