

How will the 'net-zero' target affect your local area? Assessing the local impact of the government's 'net-zero' targets for carbon emissions



The net-zero' target

It is undoubtedly true that our climate is changing. As a result, many governments around the world are setting 'net zero' target dates for carbon dioxide and other greenhouse gas emissions by their countries.

- By 'net zero', they mean that any carbon dioxide and other 'greenhouse' gases released to the atmosphere will be balanced by the removal of these gases somewhere else, resulting in 'net-zero' release of the gases in their country.
- Many countries are setting 2050 or 2045 as their 'net-zero' target dates.
- The main greenhouse gases and their effects are discussed in the 'Context' section below.
- The reduction of 'greenhouse gas' emissions is called 'mitigation'. This attempts to reduce the amount of these gases reaching the atmosphere and so reduce the 'enhanced greenhouse effect' on world and local climate.
- Potential effects of climate change include changes in sea level, in temperature and rainfall, in coastal risk and inland flood risk and in water supply.
- Climate change and its effects are being tackled by 'adaptation', where countries try to adapt to the new climate situation.

Your local area

Go with your group to a local area where you have a good view of the surrounding region, just look out of the window, or study a view on a screen.



View of a UK town in its region – Wells in the Mendip area.
(Mr. Eugene Birchall, cc-by-sa 2.0).

Discuss the possible 'mitigation' measures in the list below and then the potential 'adaptation' measures. For each of these discuss:

1. Could this activity happen here, in this area?
2. If it could, what impact might it have?
3. If it could happen here, should it happen here?
4. If it cannot or should not happen here, but will have to happen somewhere else, what will the impacts be on that community and region?

Possible mitigation measures

Use alternative energy sources to the fossil fuels that release greenhouse gases, such as:

- energy from solar farms;
- energy from wind turbine arrays;
- energy from a tidal barrage;
- energy from nuclear fuel with the necessary storage of high-level radioactive waste;
- growing biofuel;
- 'blue' hydrogen;
- extracting geothermal energy;

- local 'Archimedes screw' hydroelectric projects;
- extracting energy from waste incineration;
- installing ground or air source heat pumps
- using methane from waste disposal sites.

(Note: a comparison table of the power produced by some of these sources is included at the end of this sheet.)

Use fossil fuels, but stop them releasing greenhouse gases by:

- storing the carbon that would have been released (carbon capture or carbon sequestration).

Store energy from sources that give irregular energy supplies by:

- more efficient networks of batteries;
- hydroelectric pumped storage;
- 'green' hydrogen;
- storing compressed gases underground.

Provide raw materials for new technologies to reduce carbon emissions, such as for:

- electric cars and the electric charging network;
- enhanced insulation of buildings.

Remove carbon from the atmosphere by:

- supplying and spreading crushed rock for enhanced weathering;
- planting trees extensively.

Possible adaptation measures

- In response to rising sea level and coastal flooding – coastline management measures.
- In response to increased likelihood of inland flooding from higher storm rainfall – flood management measures.
- In response to increased likelihood of landslides and rockfall – extra monitoring and addressing of problems.
- In response to reductions in surface or groundwater supply – identifying new water sources.
- Agricultural responses to a different climate – exploring new methods and crops.
- In response to more summer heatwaves – installing methods for cooling homes efficiently.
- Developing the local structures necessary to cope with these problems, including educating the local population.

Further Earthlearningideas provide more information and discussion on many of these issues.

The back up

Title: How will the 'net-zero' target affect your local area?

Subtitle: Assessing the local impact of the government's 'net-zero' targets for carbon emissions.

Topic: Discussions about how climate change mitigation and adaptation measures might affect the local area.

Age range of pupils: 14 years upwards

Time needed to complete activity: from 15 minutes to two hours depending on what the potential of the local area is and the levels of discussion

Pupil learning outcomes: Pupils can:

- explain how climate change mitigation and adaptation measures could affect their local area;
- decide whether some of the measures should be taken locally;
- explain what effects these measures might have on communities and regions elsewhere in the world.

Context:

Government 'net-zero' targets will affect many areas across the world. This Earthlearningidea explores what the impacts might be in a local area. Extra background information is provided in other Earthlearningideas.

The greenhouse effect

The greenhouse effect is caused by visible light being absorbed by the ground surface and then re-radiated as infrared radiation. Much of this escapes from the atmosphere, but some interacts with molecules of the so-called 'greenhouse gases' such as carbon dioxide, water vapour and methane. These absorb and re-radiate the radiation so that it cannot escape from the atmosphere. It is this effect that keeps the surface of the planet warmer than it would otherwise be. You can explore this further through the 'Is the greenhouse effect happening outside today? Earthlearningidea at: http://www.earthlearningidea.com/PDF/310_Greenhouse_effect.pdf. We should be glad about the greenhouse effect, because without it, the surface of the Earth would be frozen, and we could not live here.

The enhanced greenhouse effect

Measurements show that the amount of carbon dioxide in the atmosphere has been increasing, and this is thought to be causing an increased or enhanced greenhouse effect. It is this enhanced effect which seems to be changing the climate, with its impacts on sea level, storms, droughts, water supply and other factors affecting the environment. You can explore the ice core evidence for this in the 'How can the ice core evidence for climate change be explained?'

Earthlearningidea at:

http://www.earthlearningidea.com/PDF/285_Ice_core_evidence.pdf

Geothermal energy

Sometimes ground source heat pumps are described as geothermal energy sources but as most of the energy comes from warming of the ground by solar power, rather than Earth-generated geothermal power, describing these as providing geothermal energy can be confusing. More on geothermal energy can be found in the Earthlearningidea:

https://www.earthlearningidea.com/PDF/95_Rock_power.pdf

Following up the activity:

Evaluate the possibilities for energy sources alternative to fossil fuels using the Earthlearningidea, 'What is/are the least bad option(s) for plugging the future global energy gap?' at

http://www.earthlearningidea.com/PDF/343_Plugging_energy_gap.pdf

Some of the potential effects of climate change are summarised at:

<https://www.metoffice.gov.uk/weather/climate-change/effects-of-climate-change>

- The Earth's climate is changing.
- Most scientists believe that the emission of carbon to the atmosphere by human activity is causing an enhanced greenhouse effect contributing to climate change.
- Many governments are setting target dates to become 'net-zero' contributors of carbon to the atmosphere in the fairly near future.
- These targets will affect the Earth both globally and locally.
- Local potential impacts can be explored and evaluated.

Thinking skill development:

Through construction, the potential impact of a climate change mitigation or adaptation measure can be visualised. Discussing its impact from different perspectives will cause cognitive conflict and explanations will involve metacognition. Applying these ideas to other environments involves bridging.

Resource list:

- a view, either from a hill, a window or on a screen

Useful links:

Search 'net-zero' on the Earthlearningidea website to find other Earthlearningideas relating to climate change mitigation or adaptation; a full list is on page 5 below. Use a search engine like Google to explore the internet for more information about likely global impacts of 'net-zero'.

In the UK, you can access a tool to help visualise how climate change might affect your local area at: <https://www.bbc.co.uk/news/resources/idth6338d9f-8789-4bc2-b6d7-3691c0e7d138>

Source: Chris King of the Earthlearningidea Team. Thanks to Dr. Simon Waldman (Hull University) for technical advice.

This information was as accurate as possible in spring 2021.

Underlying principles:

Earthlearningidea team. The Earthlearningidea team seeks to produce a teaching idea regularly, at minimal cost, with minimal resources, for teacher educators and teachers of Earth science through school-level geography or science, with an online discussion around every idea in order to develop a global support network. 'Earthlearningidea' has little funding and is produced largely by voluntary effort.

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Energy production from various power sources

Type	Locality	Output MW	Date
Hydro	Three Gorges Dam, China	22,500	2020
Coal	Datang Tuoketuo, China	6,700	2020
Natural gas	Surgut 2, Russia	5,600	2019
Coal	Belchatow, Poland	5,300	2020
Natural gas	Futtsu, Japan	5,040	2019
Coal + biomass	Drax, Yorkshire, UK	3,960	2020
Wind	Dogger Bank, UK (<i>proposed</i>)	3,600 predicted	?
Solar	Bhadla Solar Park, India	2,245	2020
Nuclear	Heysham II-1 and II-2, UK	1,220	2020
Hydro	Dinorwig, Wales, UK	1,800	2020
Geothermal	The Geysers, USA	1,250	2018
Wind	BARD offshore 1, Germany	400	2019
Tidal	Lake Sihwa, South Korea	254	2019
Oil	La Tablada Power Plant, Argentina	230	2019
Wind	Single wind turbine	2	2021
Hydro	Single micro-hydroelectric project	0.35	2021

Notes:

- The MW rating is the maximum power output. and is analogous to the maximum speed of a car; the car does not always travel at its maximum possible speed, neither does the power station always produce its maximum output.
- 3500 MW will give power to about 4.5 million houses.
- Hydro - the world's top six power stations in terms of output are all hydro-electric.
- Wind - The theoretical maximum energy extraction from wind is 59% (Physicist - Betz, 1919)
- Wind - The actual output of a typical wind turbine is about 2 MW and is achieved between 17 and 25 m s⁻¹ wind speed. Output is around 50% at 10 m s⁻¹ (about 36 km/h or 22 mph). At the moment they are shut down at 25 m s⁻¹ (about 94 km/h or 58 mph) to avoid damage.

The 'How will the 'net-zero' target affect your local area?' series of Earthlearningideas

Topic		Earthlearningidea title	
Possible mitigation measures	Introduction	How will the 'net-zero' target affect your local area?	
	Use alternative energy sources	Solar	Harnessing the power of the Sun
		Wave	Harnessing the power of waves
		Wind	Farming the wind: through onshore and offshore windfarms
		Tidal	Tidal energy
		Nuclear	Nuclear power - harnessing the energy of the atom
		Nuclear waste	Nuclear waste disposal
		Biofuel	Liquid biofuels: keeping our wheels turning into the future
		'Blue' hydrogen	Blue hydrogen: the fuel of the future? <i>Also:</i> Hydrogen of many colours
		Geothermal – hot rocks	Deep geothermal power from 'hot dry rocks': an option in your area?
		Geothermal – flooded mines	A new use for old coal mines
		Hydro – small scale	Small-scale hydroelectric power schemes
		Heat pumps	Heat from the Earth
		Waste – incineration	Energy from burning waste
	Waste – methane	Energy from buried waste	
	Stop fuels releasing greenhouse gases	Carbon capture	Capturing carbon?
	Store energy from sources that give irregular energy supplies	Batteries	Nuclear batteries: the future?
		'Green' hydrogen	Green hydrogen used to even out renewable energy supplies? <i>Also</i> Hydrogen of many colours
		Hydro – storage	Matching supply and demand using stored water
	Provide raw materials for new technologies	Compressed gas	Storing gas underground: What can we store? How can we do it? How will it help?
		Electric vehicles	Electric vehicles: the way to go?
	Remove carbon from the atmosphere	Insulation	How do I choose the best insulation?
		Enhanced weathering	Speeding up nature to trap carbon dioxide
	Possible adaptation measures	Tree planting	Let's plant some trees
		Coastal flooding	How will rising sea level affect our coastlines?
		Inland flooding	Inland flooding: a Sheffield case study
Landslides		Landslide danger	
	Agriculture	The future for global agriculture	