What is/are the least bad option(s) for plugging the future global energy gap?
A discussion on the least-damaging ways to meet world energy needs in the future

Most predictions about future world energy use show the trend shown in the table.

Year	2020	2030	2040
		Prediction	
Total world energy use (quadrillion Btu)	610	660	730
% from oil	33	?	
% from coal	27		
% from natural gas	22		
% from nuclear	5		
% from renewables	13	17	18

Btu = British thermal units.

This shows that, even if the percentage of energy provided by renewable fuels rises as predicted, most of our energy supplies will have to come from other sources in the future. Even if renewables increased at double or even triple the predicted rate, this would still be true.

So the key question for the world is, 'Which is or are the least bad option(s) for filling this energy gap?'

Think about the different choices for providing energy given below and either: a) write a report recommending which of the least bad option(s) should be followed, or b) divide into seven groups; each group should consider one option; then run a debate to present the group findings; finally write a newspaper report summarising the debate and the result.

You could research the internet for other key factors to be taken into account for each fuel.

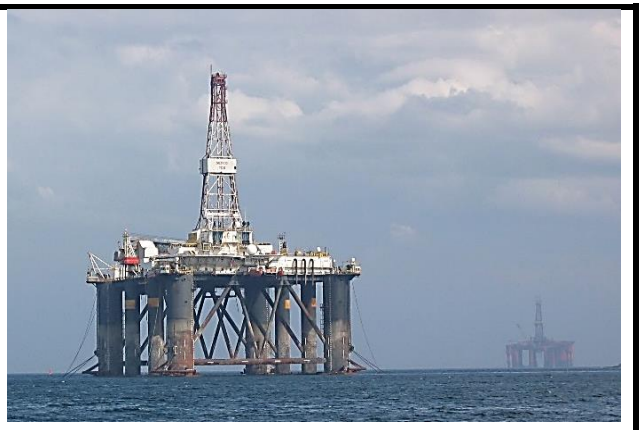
Coal

- there are abundant coal reserves worldwide
- coal is relatively cheap to extract, from large opencast sites
- burning coal releases much more greenhouse gas and pollutants than other fuels
- other factors?

Singareni opencast coal mines at Manuguru, Khammam district, Andhra Pradesh, India. *(Adityamadhav83 under the Creative Commons Attribution-Share Alike 3.0 Unported license.)*

Oil from oilfields

- there are good global oil reserves
- energy from oil releases more greenhouse gas and pollutants than natural gas
- oil often has to be imported by tankers or pipelines
- transportation and the fuel losses during transportation have their own 'carbon footprint' (e.g. fuel used in transportation releases greenhouse gas and pollutants)
- environmental controls and health and safety standards are often lower in the exporting countries than the importing countries
- some oil-exporting countries are politically unstable
- other factors?



Oil rigs in the North Sea off Scotland. *(Released into the public domain by Renata at English Wikipedia.)*

Natural gas from fracking

- this may be available locally
- fracking may cause local Earth tremors
- in regions where there are few environmental controls, natural gas can leak into the air or the water table
- there is often resistance to fracking from local people
- other factors?

Fracking Site in Warren Center, Pennsylvania, USA. *(Image by Ostroff Law under the Creative Commons Attribution 3.0 Unported license.)*

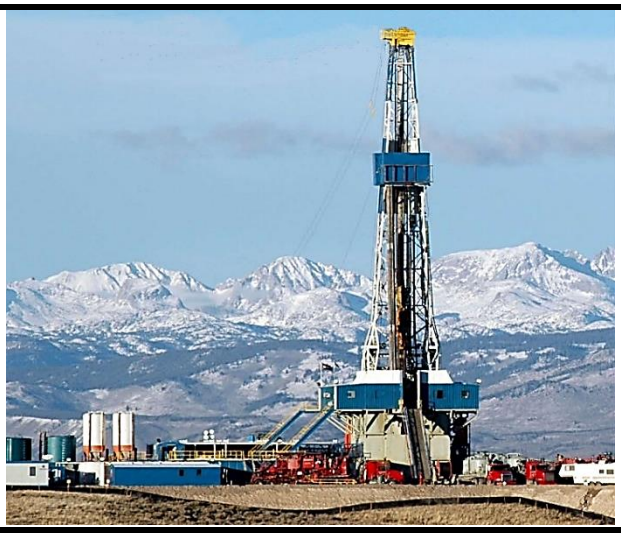
Oil from oil sands and oil shales

- extraction needs large volumes of water
- extraction damages the surface environment
- extraction causes air pollution
- carbon emissions from oil sands are 12% higher than from normal oil deposits
- the oil has to be moved by pipeline or tanker and each has its own 'carbon footprint' (e.g. fuel used in transportation releases greenhouse gas and pollutants)
- other factors?

Põhja-Kiviõli oil shale mine near Kohtla-Järve, Estonia. *(Image by Wilson44691 released under the Creative Commons CC0 1.0 Universal Public Domain Dedication.)*

Natural gas from gasfields

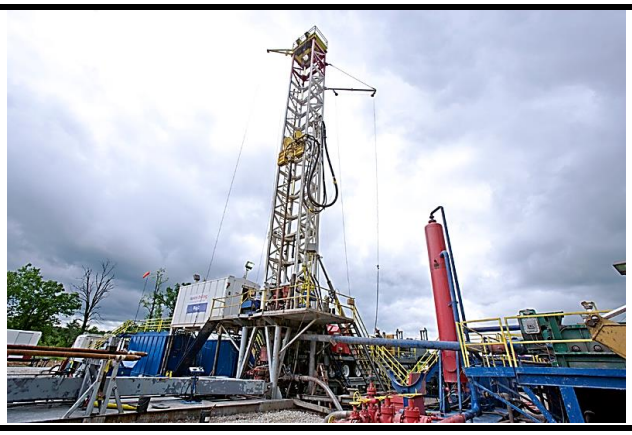
- natural gas often has to be imported by pipelines or tankers
- transportation and the fuel losses during transportation have their own 'carbon footprint' (e.g. fuel used in transportation releases greenhouse gas and pollutants)
- environmental controls and health and safety standards are often lower in the exporting countries than the importing countries
- some gas-exporting countries are politically unstable
- other factors?



Natural gas drilling rig, Wyoming, USA. *(Image by The Pinedale Field office of the BLM Wyoming State Office - in the public domain.)*

Coal, oil or natural gas with carbon capture

- carbon capture will remove the greenhouse gases from power stations so that they can be permanently stored underground
- carbon capture is not yet commercially viable
- it may never be commercially viable
- the captured carbon will have to be moved by pipeline – this has its own 'carbon footprint' (e.g. fuel needed for pumping)
- other factors?



Carbon capture technology at a coal mine. *(Image by Peabody Energy, Inc. under the Creative Commons Attribution 3.0 Unported license.)*

Nuclear power

- this releases no greenhouse gas (apart from in making concrete during building)
- nuclear waste has to be permanently and safely disposed of
- there is a risk of disastrous radiation leaks
- some countries have banned the use of nuclear power
- other factors?

Olkiluoto Nuclear Power Plant, Eurajoki, Finland. *(Published with the friendly permission of Framatome ANP, Germany under the Creative Commons Attribution-Share Alike 3.0 Unported license.)*

The back up

Title: What is/are the least bad option(s) for plugging the future global energy gap?

Subtitle: A discussion on the least-damaging ways to meet world energy needs in the future.

Topic: Pupils discuss the best ways (or least harmful ways) of meeting future global energy needs.

Age range of pupils: 14 years upwards

Time needed to complete activity: 30 minutes

Pupil learning outcomes: Pupils can:

- explain why the future world energy needs cannot be met by renewable fuels in the foreseeable future;
- explain which of the non-renewable energy sources is likely to provide the best options for future energy needs.

Context:
Given that renewable fuel sources will be unable to fulfil all global energy needs for the foreseeable future, pupils consider which of the alternative sources might plug this energy gap. They can either do this individually or in groups, presenting the results in a later debate. The alternatives are presented in boxes in the sheet above so that these can be cut up into cards to be given to each group. Internet research will provide additional background information.

The figures in the table are approximations from the graph in the International Energy Outlook report published by the U.S. DOE Energy Information Administration in 2017 (World energy consumption projection 1995-2011.png) and released into the public domain. Other predictions are similar.

Following up the activity:
Pupils could research the internet for which of the renewable sources is likely to make the biggest contribution(s) to future world energy needs.

Underlying principles:

- There is no 'silver bullet', 'quick fix' or simple solution to providing for future global energy needs in ways that do not damage the environment.
- Therefore we need to choose the least harmful option or options for providing future energy needs.
- These options are either fossil fuels or nuclear.

Thinking skill development:
Cognitive conflict is a central point of this activity, which seeks the least harmful option. Pupils may also develop their debating and reasoning skills.

Resource list:

- if this activity is to be run as a debate, each different group will need an information card

Useful links:
Put 'future global energy needs' into an internet search engine like Google.

Source: Chris King of the Earthlearningidea Team.