Oxford Revise | Edexcel A Level Geography | Answers

Chapter 8

All exemplar answers given are likely to be in the top mark band.

All questions are point-marked.

1 AO1 = 6

Level	Marks	Description
	0	• No rewardable material.
1	1–2	• Demonstrates isolated elements of geographical knowledge and understanding, some of which may be inaccurate or irrelevant. (AO1) • Understanding addresses a narrow range of geographical ideas. (AO1) • Understanding of geographical ideas lacks detail. (AO1)
2	3–4	• Demonstrates geographical knowledge and understanding, which is mostly relevant and may include some inaccuracies. (AO1) • Understanding addresses a range of geographical ideas. (AO1) • Understanding of geographical ideas is not fully detailed and/or developed. (AO1)
3	5–6	• Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1) • Understanding addresses a broad range of geographical ideas. (A01) • Understanding of geographical ideas is detailed and fully developed. (AO1)

Relevant content may include:

- The long-term nature of the geological cycle (100–200 million years).
- The amount of carbon moved every year 0.01–0.1 Gt.
- Volcanic outgassing returns carbon dioxide (CO_2) into the atmosphere from the mantle (and into the ocean from underwater eruptions). This is a transfer (flux) from the lithosphere.
- Volcanic outgassing can occur at convergent or divergent plate margins, as well as volcanic hotspots.
- Chemical weathering of rocks starts with a weak carbonic acid being created as CO_2 mixes with rainwater, which reacts with the minerals in the rock, breaking them down into component ions of carbon, oxygen, and calcium. These are transported in rivers to the oceans where they combine with bicarbonate ions to form calcium carbonate and precipitate out as calcite.
- Deposition, accumulation, cementation, diagenesis, and lithification combine to turn calcite sediment into limestone.
- Subduction at plate margins melts the limestone, during which oxidation occurs and chlorine gas (Cl_2) is released, which is then vented during an eruption.
- Tectonic uplift can also expose previously buried limestone.

Example answer: *Carbon is transferred from the atmosphere to the lithosphere by chemical weathering, during which rain combines with carbon dioxide to form a weak carbonic acid. This reacts with rock minerals, breaking them down into their component ions of carbon, oxygen, and calcium. Rivers transport these ions to oceans*

where they combine with bicarbonate ions to form calcium carbonate. Over long periods of time, calcium carbonate is deposited on the sea floor and through a series of processes such as cementation is turned into limestone. The carbon contained in the limestone can be returned to the atmosphere when subduction at plate margins melts the rock and carbon dioxide is released, which is then vented during an eruption in a process known as volcanic outgassing.

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Relevant content may include:

- There is accumulation of sediments and organisms on the sea floor, which degrade over time.
- Fossil fuels are formed from biologically derived carbon from decomposed organisms.
- Continued accumulation leads to increasing pressure and heat (compression) of the sediments on the bottom, leading to chemical reactions and the formation of insoluble geopolymer compounds.
- Thermocatalytic reactions occur when pressure and heat are intense due to compression and burial, leading to creation of rocks rich in organic matter.
- At depths of greater than 2500 m, oil and gas can form.

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Relevant content may include:

- Photosynthesis is the largest transfer of carbon. Terrestrial primary producers transfer 123PgC/yr and marine phytoplankton 80PgC/yr.
- Respiration returns 197.1PgC/yr from land and sea to the atmosphere. Therefore, photosynthesis creates carbon sinks in terrestrial and marine biomass.
- It sequesters carbon from the atmosphere to the biosphere where it is stored in biomass and soil once plants die and decompose. Therefore, photosynthesis helps to regulate the atmospheric store of carbon.
- It is especially high where there are no limiting factors such as less daylight, lower temperatures, or lack of water (e.g. mangrove forests).
- About 1000 times more carbon dioxide is taken from the atmosphere by photosynthesis than is released back to it.

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Relevant content may include:

- The carbonate pump sequesters CO2 through photosynthesis by phytoplankton in surface waters.
- CO2 also dissolves in the ocean and reacts chemically with water to form carbonic acid.
- Carbonic acid reacts chemically to form calcium carbonate in the shells and skeletons of marine organisms: e.g. crabs, zooplankton, and oysters.

- These organisms sink to the deep ocean when they die and accumulate on the seabed forming calcareous ooze and limestone in the longer term where carbon is locked into the geological cycle.
- Respiration and decomposition return some gaseous carbon to the atmosphere, but this is less than the rate of respiration, so the ocean is a carbon sink.
- Cooler oceans can absorb more CO2 than warmer oceans.

Example answer: *Carbon dioxide can be dissolved into surface waters of the ocean. This is because there is a difference in pressure between the atmosphere and the ocean. When the pressure is higher in the atmosphere CO2 dissolves into the ocean.*

Carbon dioxide is also transferred by photosynthesis. Microscopic phytoplankton and zooplankton use sunlight to photosynthesize, taking in CO_2 and converting it into organic matter. This process is more rapid in the tropics and shallow oceans.

When phytoplankton die or are eaten by other marine organisms, some of the carbon contained in their bodies sinks to the deeper parts of the ocean. This transfer of carbon from the surface to the deep ocean is known as the biological pump. It removes CO_2 from the atmosphere and stores it in the ocean's depths for long periods.

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Relevant content may include:

- LICs have lower energy consumption per capita due to inaccessibility such as limited electricity supply in rural areas or lower disposable incomes.
- Many people rely on biomass (e.g. wood or dung) as it is free or cheaper for heat and cooking.
- Agricultural energy consumption is low in LICs as most are subsistence farmers, whereas in HICs it is high due to mechanised agricultural systems.
- Transport and car ownership in emerging economies and HICs increases energy consumption.
- Emerging economies tend to have large manufacturing industries which also increases energy consumption.
- As technology develops and energy efficiency improves per capita, consumption decreases in HICs.

- Government policies encourage energy efficiency in some HICs alongside public awareness and perception around sustainable lifestyles.

6 AO1 = 3 / AO2 = 3

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3	5–6	• Demonstrates accurate and relevant geographical knowledge and understanding throughout. (AO1) • Applies knowledge and understanding to geographical information logically to find fully relevant connections/relationships between stimulus material and the question. (AO2)

Relevant content may include:

- Lower in Europe and becoming a sink, as is the USA (AO2), as many countries focus on afforestation, which then increases biomass and rates of photosynthesis, which transfers CO_2 from the atmosphere into the biomass store. (AO1)
- Exponential growth in South Asia (AO2), as many countries have high population growth rates and high total populations (AO1), but also increasing affluence, which increases demand for energy and food, particularly meat-based diets (AO1). Also, many NICs in this region of the world where, due to industrialisation, land-use change is rapid. (AO1)
- Exponential growth in South America (AO2), as there are many tropical rainforests there such as Brazil (AO2) and rates of deforestation are high due to land-use change to agriculture to grow food and biofuels (AO1). Deforestation reduces carbon storage in forests and soils, reducing pedosphere storage, and ploughing releases carbon into the atmosphere. (AO1)

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Relevant content may include:

AO1

- The role of deforestation in increasing atmospheric CO_2 due to reduced photosynthesis. Deforestation, anthropogenic climate change and shifting climate belts are creating positive feedback loops leading to, for example, more frequent droughts.
- Human activities (burning fossil fuels, land degradation etc) in transfer large quantities of carbon from long-term geological stores into the atmosphere.
- The CO_2 fertilisation effect that results from increased levels of carbon dioxide in the atmosphere has increased the rate of photosynthesis in plants.

AO2

- Reference to a range of ideas from the diagram, and use of vocabulary and concepts from the diagram in a meaningful way.
- Developed connections and explanations of how processes are modified and become positive feedback loops.

8 AO1 = 3 / AO2 = 3

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Relevant content may include:

AO1

- Projected global surface warming is related to continued combustion of fossil fuels, which add CO_2 to the atmosphere, enhancing the greenhouse effect.
- Temperature increases are driven by industrialising economies.
- Range is caused by uncertainty over several human and physical factors and how these may change.

AO2

- There is a range of possible future rises in temperature of between 2 and 4 degrees Celsius linked to a range of emission scenarios.
- Highest warming would be caused by factors such as:
  - Continued dependence on fossil fuels for economic growth and minimal initiatives to diversify energy mixes to renewable energy sources.
  - Positive feedback loops amplifying warming, such as thawing in permafrost in the Arctic.
  - Lack of investment into viable mitigation strategies.
- Lowest warming would be caused by factors such as:
  - A reduction in greenhouse gas emissions by more investment and success of alternative energy sources.
  - Countries ratify commitments made at the Paris Agreement into national laws.
  - Future economic growth is decoupled from fossil fuels.

9 AO1 = 8

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Relevant content may include:

- Government policies to decarbonise energy supplies lead to greater use of renewable sources; the UK and Norway aim to do this by 2050. The UK currently generates around 30% of electricity demand from wind, Norway generates 72% form renewables.
- Energy systems, such as in Norway, are highly electrified to heat and light homes and industry, whereas the UK still relies heavily on natural gas.
- Physical availability: countries rich in oil and gas use a lot as it decreases cost and makes them more energy secure (e.g. Saudi Arabia). The UK government recently announced plans to open up Rosebank, a large North Sea Oil and Gas field. Norway is rich in oil and gas and exports most of it.
- HICs have more capital to invest in more complex technologies, which enable resources such as nuclear to be exploited.
- As the relative cost of renewables decreases and prices of oil and gas rise, there is a cost benefit in investing in renewable technologies.
- The key goal of governments is for energy security, which is achieved through exploiting domestic resources and building political alliances with allies. This will affect which energy resource is used in their mixes.

Example answer: *Physical availability of different energy sources within a country varies. For example, due to geology, some countries, such as the UAE, are rich in fossil fuel deposits (e.g. oil) and will therefore use these as a major part of their energy mix. In contrast, other countries may have to rely on imported fossil fuels and so seek alternatives within their energy mixes. Secondly HICs have more capital to invest in more complex technologies, which, if combined with favourable conditions for FDI in market-led economies, leads to growth and investments in renewable technologies. As well as this, government policies will determine the relative importance of different energy sources in energy mixes. For example, the UK government is seeking to decarbonise the country's electricity supply by 2050, which has meant investment into wind and solar as well as the construction of Hinkley Point C in Somerset which, when online, will provide 7% of the UK's electricity. Finally historical policies and investments can determine current energy mixes. For example, the UK is heavily reliant on natural gas due to decisions in the past. In contrast, Norway has a much more electrified system to power homes, much of which is generated from hydroelectric power.*

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Relevant content may include:

- Bilateral agreements (e.g., ENSO pipeline from Russia to China) are less prone to disruption than multilateral agreements (e.g. Russian gas to the EU).
- The longer a pathway is, the more prone to disruption. For example, shipping lanes passing through choke points such as the Suez Canal, or areas of piracy such as the Straits of Malacca.
- Disruption is more frequent when the producing country/region are politically unstable (e.g. Iraq and the Middle East).
- Oil and gas have frequently been at the root of international tensions (e.g. Russian gas to the EU). Development of reasons for this, such as tensions over Ukraine joining the EU and NATO, invasion by Russia of a sovereign nation, how this war has exposed the EU's reliance on Russian gas and resulting price rises on energy and goods and services.
- Choke points (e.g. the Suez Canal or Red Sea) are particularly vulnerable due to political instability and terrorism.

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Relevant content may include:

- A national commitment will lead to a decrease in the use of fossil fuels as a primary energy source, whether domestic or imported. For example, all coal-fired power stations are due to close in 2025 and the production of oil and gas has been decreasing since 2000.
- It will lead to an increase in the investment and the use of renewable energy sources, although this depends on the climate of a country. For example, solar contributes up to 4.4% of the energy mix and wind up to 30%; in other countries this would vary.
- Government policies will shift toward more radical technologies. For example, electric vehicles or carbon capture and storage or hydrogen fuel cells.
- Government policies will also shift towards a focus on efficiency to reduce energy consumption per capita and the national carbon footprint.
- Biofuels may be used, such as in Brazil, as the process of burning biofuels is carbon neutral: CO_2 taken in by a plant during photosynthesis will then be released during combustion.

12 AO1 = 8

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Relevant content may include:

- Positive feedback loops could amplify warming as:
  - More CO_2 and methane could be released from biosphere due to thawing of permafrost in the Arctic, which would enable trapped gases to escape. Gas would enter the atmospheric store, trapping more terrestrial heat energy and leading to more warming.
  - More warming, causing shifting climate belts, and more droughts, leading to waterlogged peat deposits, which are rich in carbon, drying out as the water table falls, thus enabling the escape of greenhouse gases. Methane has a warming capacity 21-times greater than CO_2.
- Negative feedback loops could slow down warming as:
  - There could be an increase in the rate of plant growth (net primary productivity) as there is more CO_2 in the atmosphere, so the biosphere increases its capacity as a carbon sink, so mitigating against atmospheric warming. Equally, vegetation may become more widespread in high latitudes of the Northern Hemisphere, as taiga and boreal forests may migrate north due to higher temperatures.
  - An increase in cloud cover caused by more water vapour held in warmer air could reflect more solar radiation, reducing the amount of solar radiation which reaches the surface and therefore reduces the amount of terrestrial radiation being absorbed by greenhouse gases.
- Tipping points include:
  - Atlantic Thermohaline Circulation could collapse due to changes in water density and salinity caused by melting ice sheets. This would weaken the flow of the North Atlantic Drift, meaning that less heat is transferred towards the higher latitudes of Western Europe. This would change temperatures of countries like the UK significantly.
  - The dieback of tropical forests due to shifting climate belts, leading to increased drought, meaning that these become a carbon source rather than a carbon sink.

13 AO1 = 3 / AO2 = 9

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Relevant content may include:

AO1

- Collapse of ecosystems due to climate warming can have impacts on biodiversity.
- Knowledge of short- and long-term stores (e.g. atmosphere, biosphere, and pedosphere), processes (e.g. photosynthesis and respiration) which transfer carbon.
- Tundra is found in the Arctic where climate change impacts are amplified and melting permafrost is significant for future climate change.
- Uncertainty over the rate of these processes and therefore the possible impacts.

AO2

- Connections and relationships between the melting of permafrost and subsequent release of methane and CO_2 from the biosphere store into the atmospheric store, leading to climate warming.
- Connections and relationships between carbon sequestration, through photosynthesis on the biosphere store on plant productivity and soil organic matter.
- Increase in net primary productivity due to climate warming, leading to longer growing seasons and therefore increased rates of photosynthesis as fewer limiting factors.
- Greater rates of respiration, leading to greater transfers of carbon to the atmosphere.
- Relationships between increased NPP, warming climate, increased rates of decomposition, and greater soil organic matter.
- Judgements about the significance of each of the stores and fluxes. For example, the biosphere is a relatively large store of carbon, so fluxes from this could have a significant impact on the size of the atmospheric and soil carbon stores.
- There is a positive feedback loop indicated on the diagram, showing that the key effect of climate warming will be to heat up air temperatures, which will, in time, lead to increased vegetation cover and so increase air temperatures further.
- There are three greenhouse gases shown on diagram, with methane perhaps being the most significant, but there will also be changes in carbon dioxide (CO_2) and nitrous oxide (NO).
- The different peat depths indicated on the diagram will undergo different rates of change. For example, warming will increase the activity of microbes, resulting in a release of nitrous oxide, a potent greenhouse gas, with significant impacts on soil stores over years/decades.

Example answer: *Arguably the most significant negative impact of climate warming, driven by combustion of fossil fuels, is the melting of permafrost and subsequent release of methane and carbon dioxide (CO_2) from the biosphere store into the atmospheric store. This is because, with the addition of more greenhouse gases into the atmosphere, the enhanced greenhouse effect will drive further global warming, which is particularly amplified in the Arctic where taiga forest is found. In particular, the release of huge volumes of methane gas from the permafrost is concerning as it has a warming potential 28-times greater than CO_2. Additionally, the release of these gases is from ancient stores which are trapped deep underground in the large biosphere and soil carbon stores, adding to further imbalances in the carbon cycle.*

Another significant impact shown on the diagram is that a warming climate could drive increased rates of photosynthesis, respiration, and decomposition. This is because, as temperature increases, plants can grow for longer. In other words, net primary productivity would increase, although daylight is still going to be a limiting factor. With increased temperature in the taiga, biodiversity may also increase, which in turn will increase photosynthesis. With increased rates of decomposition in a warmed environment, the transfer of carbon in the soil carbon store will also increase, thereby trapping more CO_2 from the atmosphere. However, increased microbes in the soil would result in the release of nitrous oxide, which is a potent greenhouse gas.

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Relevant content may include:

AO1

- The carbon and water cycles are inter-related global systems, which transfer and store both water and carbon through a range of mechanisms (e.g. photosynthesis and decomposition).
- Human activity includes land-use change, including deforestation and conversion of land for agriculture.
- The impacts are on the short-term carbon cycle.

AO2

- Application of knowledge and understanding of how land-use change will alter the carbon stores of soil and plants and modify the processes that transfer carbon, such as reduced leaf litter from leaf fall and therefore less decomposition, which in turn leads to less organic matter in soils.
- Understanding of how some of these modifications will be long-term (e.g. aquifer groundwater storage) and others short-term (e.g. more CO_2 released into the atmosphere when ploughing occurs, which is a seasonal activity).
- Positive feedback loops occur, which destabilise the water and carbon cycles. For example, deforestation impacts the pedosphere, the atmosphere, and the biosphere, interrelated processes are modified, and systems become unbalanced and may reach tipping points.
- Judgements of which impacts are the worst.
- Connections and relationships between the causal factors and impacts.
- Afforestation is a human activity which brings positive rebalancing and will increase biomass storage of carbon as trees take carbon from the atmosphere through photosynthesis.

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Relevant content may include:

AO1

- Knowledge and understanding of the workings of the water and carbon cycles.
- Understanding as to how degradation of both cycles occurs via a range of human activities, as resources of water and carbon are utilised for basic human needs and economic prosperity (for example, deforestation, changing agricultural land use, fossil fuel combustion, or types of pollution).
- Understanding that humans can be impacted on a range of scales, from local to global.

AO2

- Assessment of the implications on human wellbeing such as health and security, supported by examples affecting a range of communities and countries for both cycles.
- Consideration of degradation in the water supply. For example, by melting of glaciers and ice sheets, leading to water insecurity which impacts food production, domestic supplies, and industrial development. Depletion of surface water and ground water supplies, loss of cryosphere supplies (Andes), which all lead to loss of water security, which impacts on all communities for food production, domestic supplies, and industrial development.
- Consideration of the impacts of changing land use to include deforestation, which can contribute to local and global impacts.
- Ocean acidification can lead to the destruction of primary producers, such as krill in the polar regions, or coral reefs and mangroves, which impact directly on the lives of coastal communities.
- Changes of sea level, an indirect result of global warming, can impact disproportionately on small island economies, leading ultimately to environmental refugees.
- Degradation of carbon stores by deforestation, which has major implications for climate change—the major problem for human wellbeing.
- Increased temperatures will lead to a range of impacts all impacting human wellbeing, from wildfires to flooding.

16 AO1 = 5 / AO2 = 15

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Relevant content may include:

AO1

- Knowledge of a range of places where unconventional fossil fuels are exploited.

- Concepts of energy security, peak oil, and energy pathways.
- Knowledge of the difference between fossil fuels and unconventional ones.
- Examples of unconventional fossil fuels: tar sands, shale gas and deep-water drilling.
- Fossil fuel use is still the norm for the global economy.
- 80% of global primary energy consumption is fossil fuels.

AO2

- Unconventional fossil fuels play a role in the global economy due to its reliance on fossil fuels.
- Fossil fuels are finite resources. As they run out, new technologies enable the exploitation of unconventional fossil fuels.
- The concept of energy security and the role of unconventional fossil fuels in helping with energy security. For example, important for reliable uninterrupted supplies, abundant domestic primary energy sources, and affordable energy.
- Energy security is also important for economic growth and development and helps with social stability.
- Advantages of unconventional fossil fuels such as delaying the time to peak oil, helping reduce the energy mismatch. Also improves domestic energy security (e.g. in Canada), reducing potential disruptions to energy pathways.
- Tar sands provide economic growth for rural areas and improve the energy security of Canada.
- Fracking is less polluting than coal or oil and provides the USA with 25% of its energy needs, leaving it less exposed to energy pathways.
- Deep-water oil drilling brings FDI into the Brazilian economy through investment from energy TNCs.
- Much energy infrastructure, engines, machines operate on oil, so continuing to have a source of fossil fuels would avoid changes to these, avoiding costs.
- Social and environmental impacts may slow down exploitation.
- Tar sands are highly polluting in sensitive taiga biomes, low NPP, and effects are long-term.
- Impacts on carbon cycle with movement of carbon from a long-term store into the atmosphere and resulting impacts on climate change.
- Impacts on local wildlife.
- Inevitability, the degree of exploitation will depend on decisions taken by key players such as governments, TNCs, environmental pressure groups, and local communities.

Example answer: *The view that the exploitation of unconventional fossil fuels, such as tar sands, shale gas, and deep-sea oil drilling is inevitable is a contentious topic, with valid arguments on both sides. However, with fossil fuels still contributing 80% of global primary energy needs, it currently seems likely that unconventional sources will continue to be exploited for a variety of reasons.*

A major factor in favour of their exploitation is that they bring significant economic benefits and energy security. These resources can increase domestic production of energy resources, create jobs, and stimulate economic growth, which makes their exploitation attractive to both governments and industries. For example, tar sand mining in Canada's Alberta Province has created 138,000 jobs, attracted $24.6 billion worth of capital investment and, many would argue, represent a tremendous source of secure, accessible, and affordable energy to help strengthen global energy security. Fracking for shale gas in the USA now accounts for 80% of domestic production and has dropped prices for consumers. Aside from these obvious economic benefits, it has made the USA much more energy secure by reducing dependency on foreign fossil fuel sources which are prone to disruption due to international relations and choke points along energy pathways. Domestic energy security seems to be an increasingly attractive prospect due to uncertain international relationships with energy giants

such as Russia. The lure of economic gain and energy security will continue to drive investment and extraction despite environmental concerns.

Secondly, global energy demand continues to rise, driven by population growth, industrialisation, and urbanisation, particularly in Asia. Meeting this demand solely through conventional fossil fuels may become increasingly challenging, leading to increased reliance on unconventional sources to bridge the gap between supply and demand. Demand for fossil fuels remains high across the world despite efforts to decarbonise economies. Like the tar sands in Canada, the exploitation of deep-sea oil brings much needed FDI into the Brazilian economy, but also delays peak oil. Additionally, as resources of conventional sources of fossil fuels dwindle, and technology improves, it becomes more cost beneficial to drill for oil in deep oceans.

However, there are counterarguments against the inevitability of exploiting unconventional fossil fuels such as environmental concerns. These include habitat destruction on a local scale, water pollution, and greenhouse gas emissions. For example, tar sands mines use 2.4 barrels of freshwater for every barrel of tar sands produced. Companies get the water from the Athabasca River—one of North America's longest free-flowing rivers—and nearly all of it ends up too contaminated to return. Additionally, the mines destroy boreal forest, a huge carbon store, destroy wetland, and are putting millions of birds, caribou, bears, and wolves at risk. In the fracking process, water quality is a primary concern because the hydraulic fracturing fluids used to fracture rock formations have chemicals that could harm human health and the environment, especially if they enter drinking water supplies. Increasing awareness of climate change and environmental degradation may lead to greater opposition to the exploitation of unconventional sources. Public opposition to the environmental and social impacts of unconventional fossil fuel extraction can lead to protests, legal challenges, and grassroots movements that pressure governments and companies to halt or limit their exploitation.

In conclusion, while there are economic, technological, and political factors that may drive the exploitation of unconventional fossil fuels, it is not inevitable. Environmental concerns, the rise of renewable energy alternatives, regulatory shifts, and social opposition all pose significant challenges to the continued expansion of unconventional fossil fuel extraction. The future balance between fossil fuels and cleaner energy sources will depend on a complex interplay of these factors and the choices made by governments, industries, and society as a whole.

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Relevant content may include:

AO1

- Fossil fuel use is still the norm for the global economy.

- 80% of global primary energy consumption is fossil fuels
- Knowledge of different renewable energy source and their current contribution to the energy mix.
- Knowledge of recyclable energy and radical technologies.

AO2

- Could help decouple fossil fuels from economic growth if efficiency improves.
- Renewable energy is likely to be an important component of the future energy mix as it has a low carbon footprint and the technology is always improving.
- Each renewable resource has advantages and disadvantages. However, as time progresses, the disadvantages will decrease as the technologies are improved.
- If investment continues then there are endless possibilities (e.g. Swedish motorway which charges electric vehicles as they are driven on it).
- In some countries (e.g. Norway), renewables already contribute 72% of the total energy mix due to investment and the country making use of topography and climate to harness HEP.
- In the UK, wind energy contributes around 27% of electricity demand, which will continue to rise as more wind farms are built.
- Government policies affect consumer habits. For example, by 2035 in the UK, there will be a large shift to electric vehicles due to policy change.
- Biofuels may be used more in the future. They are carbon neutral in some ways, as CO_2 taken in by a plant during photosynthesis will then be released during combustion. However, countries may be reluctant as food security may be threatened.
- The world is still hooked on fossil fuels (80% of primary sources) and so transition to renewables will be costly and require investment.
- Local resistance (NIMBYism) to renewables is significant and they can take up large areas of land.
- Nuclear energy may be the most realistic option as one power station can produce up to 7% of the energy demand. However, there are disadvantages to this.
- Radical technologies could also reduce reliance on fossil fuels (e.g. hydrogen cells and electric vehicles) although manufacture and processing may still require use of them.

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Relevant content may include:

AO1

- Knowledge and understanding of different mitigation strategies (carbon taxation, energy efficiency, afforestation, renewable switching, and carbon capture and storage)
- Knowledge about different scales of these strategies—national and global (Paris Agreement).
- Knowledge of evidence, which is likely to be from a range of places and named schemes.
- Knowledge of the difference between adaptation and mitigation as approaches to deal with future climate change.

AO2

Positive and negatives of different mitigation strategies and the extent to which they can reduce future planetary warming. For example:

- Carbon strategies—these are useful as a deterrent and to help governments decouple from fossil fuel use. However, if a tax is passed onto consumers, governments will lose popularity and votes. Governments may just choose to pay the tax as this is less costly than the decoupling process.
- Energy efficiency—an effective way of reducing energy use per capita. The UK's energy use per capita is the same now as it was in 1970s even though the standard of living is higher. This is due to efficiency of use. Germany is a world leader, with policies to reduce energy consumption in residential and commercial buildings by 25%.
- Afforestation—the most straightforward of all the mitigation strategies and commonly used to offset emissions of CO_2. Definitely debatable about the extent to which trees alone can absorb all the GHG released from fossil fuel combustion.
- Renewable switching—includes strategies such as getting electricity from renewable sources but also electric cars. Sweden is leading the world with this, leading to low carbon per capita even though its consumption per capita is high, with most electricity from nuclear and hydroelectric power stations. The UK is investing in nuclear by constructing Hinkley Point C, which will provide 7% of electric demand. However, renewables provide intermittent electricity, while fossil fuels provide the continuous power essential for current infrastructure.
- Carbon capture and storage—there is currently only one commercial carbon capture coal-fired power station in Canada, so there are questions about cost effectives and willingness of governments to invest in this technology.

Evaluation of global agreements such as the Paris Agreement to help mitigate climate change.

- While it is aiming to limit future global warming to 1.5 degree Celsius above preindustrial levels and 195 countries have adopted this legally binding agreement, there are questions about how far it will help as countries look at national interests before global ones.
- Ratification into national laws is essential and countries are held to account for progress.
- Support needs to be given to help developing countries adapt and reduce emissions.
- An overall conclusion of which strategies are the most likely to reduce global warming.
- While each one may help reduce future global warming, it is unclear how significant this will be.
- There is a lot of uncertainty about how much future global warming will rise due to human and physical factors.