

## **Evaluate the effectiveness of different energy sources in mitigating climate change on a global scale.**

[9]

Climate change is caused by human activities, mainly burning fossil fuels, which release carbon dioxide. To stop climate change, the world needs to switch to cleaner energy sources. Some of these sources are renewable energy, like solar, wind, hydro, and biofuels, while others, like nuclear power and natural gas, produce fewer emissions than coal and oil. This essay will look at how these energy sources help fight climate change and their problems.

Renewable energy is one of the best ways to reduce carbon emissions. Solar power is becoming more popular and does not release any emissions when generating electricity. Many countries, such as China and India, use solar panels to produce energy. However, solar energy only works when the sun is shining, so it is not always reliable. Wind power is another clean energy source that is used in places like Germany, but it only works when the wind is blowing. Because of this, both solar and wind power need backup energy sources.

Hydropower is more reliable because it comes from water flowing through dams. Norway uses a lot of hydropower, and it is a good alternative to fossil fuels. However, building dams can harm the environment by flooding land and affecting wildlife. Biofuels are made from plants and organic waste, and they can replace fossil fuels in cars. But growing crops for biofuels takes up land and may cause deforestation, which can make climate change worse.

Another way to reduce emissions is through nuclear power. Nuclear plants do not burn fossil fuels, so they do not produce carbon dioxide. France uses nuclear energy for most of its electricity. However, nuclear power is controversial because of the risk of accidents, like the Fukushima disaster, and the problem of radioactive waste, which is dangerous.

Natural gas is a fossil fuel, but it produces less CO<sub>2</sub> than coal and oil. Some countries, like the United States, have switched from coal to natural gas to lower their emissions. However, natural gas still pollutes the atmosphere, and leaks of methane, a powerful greenhouse gas, can make climate change worse.

In conclusion, renewable energy is important for reducing climate change, but it has problems like reliability and environmental impacts. Nuclear energy and natural gas can also help reduce emissions, but they have their own risks. A combination of energy sources may be needed to fight climate change.

## **Justification for a 5-Mark Score**

### **Some knowledge and understanding of ESS issues and concepts**

The essay shows a basic understanding of climate change and energy sources, correctly stating that fossil fuels cause emissions and that alternatives like solar, wind, and nuclear reduce them. However, the explanations lack depth and do not fully explore why these energy sources are effective or ineffective.

### **Some links between knowledge statements and the context of the question**

The essay connects energy sources to climate mitigation, but the links are not fully developed. For example, it states that hydropower is reliable but harms the environment but does not discuss how hydropower compares to other sources in reducing emissions.

### **Inconsistent use of ESS terminology**

Basic terms like carbon emissions, fossil fuels, renewable energy, and nuclear power are used correctly, but the explanations are simple. Key concepts like energy efficiency, intermittency, and sustainability are missing or only briefly mentioned.

### **Limited use of examples**

Several case studies are included (China for solar, Germany for wind, Norway for hydropower, France for nuclear, and the USA for natural gas), but they are not well explained. The examples are more like brief mentions rather than detailed supporting evidence.

### **Limited analysis and evaluation**

The essay states that different energy sources have advantages and disadvantages, but it does not compare them in detail or discuss how they work together. There is no deep evaluation of which energy sources are the most effective overall.

### **Basic conclusions, but not well supported**

The conclusion says that a mix of energy sources is needed, but this is not strongly justified. There is no discussion of how different sources could be combined to solve climate change more effectively.

# How to Improve the Essay to Earn a Higher Mark

To improve this essay, focus on the following areas:

## 1. Expand Analysis and Explanation

Currently, the essay mentions advantages and disadvantages but does not fully explain why they matter. To improve:

- Explain why solar and wind's intermittency is a problem and how energy storage or backup systems can solve it.
- Discuss why nuclear power is efficient and how it compares to renewables.
- Explain the long-term sustainability issues of biofuels and natural gas.

### Example improvement:

Instead of just saying, *"Solar energy only works when the sun is shining, so it is not always reliable,"* the student could write:

*"Solar energy is a zero-emission source, but its biggest limitation is that it only produces electricity during daylight hours. This means countries must invest in battery storage or backup power from other sources like hydropower or nuclear to ensure a constant energy supply."*

## 2. Use More Detailed Case Studies

The essay mentions countries like China, Germany, and Brazil, but it only briefly states that they use certain energy sources. To improve:

- Give a specific example of a solar or wind farm in China or Germany.
- Show how nuclear power helped France lower its emissions.
- Explain how the USA switching from coal to natural gas affected its carbon footprint.

### Example improvement:

Instead of just saying, *"France uses nuclear energy for most of its electricity,"* the student could write:

*"France generates around 70% of its electricity from nuclear power, reducing its dependence on fossil fuels and cutting emissions. As a result, France has one of the lowest per capita carbon footprints in Europe."*

## 3. Compare Energy Sources More Clearly

The essay lists energy sources separately but does not compare their effectiveness. To improve:

- Compare solar and wind to nuclear in terms of reliability.
- Compare hydropower to fossil fuels in terms of long-term sustainability.
- Explain whether natural gas is a good transition fuel or just another fossil fuel.

### Example improvement:

Instead of just saying, *"Nuclear power is efficient but controversial,"* the student could write:

*"While nuclear power is more reliable than solar and wind, its risks—such as accidents and radioactive waste—make some countries hesitant to invest in it. In contrast, renewable energy sources like solar and wind are safer but require backup storage due to their intermittency."*

## 4. Improve the Conclusion

Right now, the conclusion is **too simple** and does not justify the final argument. To improve:

- Summarize which energy sources are **most effective for the long term**.
- Acknowledge that **different countries may need different solutions**.
- Provide a **final evaluation** instead of just saying a mix is needed.

### Example improvement:

Instead of saying, "A combination of energy sources may be needed to fight climate change," the student could write:

*"Overall, renewable energy sources like solar, wind, and hydropower are the most sustainable options for reducing climate change, but they require energy storage and infrastructure improvements. Nuclear power is highly effective at reducing emissions but remains controversial due to safety risks. In the short term, natural gas may help transition away from coal, but it is not a long-term solution. The best strategy will depend on each country's resources, economy, and commitment to sustainability."*