



# International Journal of Multidisciplinary Research and Growth Evaluation.

## An analysis of the impacts of climate change on green economy of Sierra Leone

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### Article Info

**ISSN (online):** 2582-7138

**Volume:** 03

**Issue:** 02

March-April 2022

**Received:** 02-02-2022;

**Accepted:** 18-02-2022

**Page No:** 61-66

### Abstract

The above-mentioned United Nations Environmental Protection (UNEP) Green Economy Initiative (GEI) defines a green economy as “one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities”. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive.” Others such as OECD, World Bank and Global Green Growth Institute (GGGI) use the term ‘green growth’, which is similar to the concept of green economy yet slightly different in terms of its implementation approach. The OECD Green Growth Report defines green growth as “fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies”. Hence, both operate on the basis of development within planetary boundaries. Growth is an element of both concepts, but the question remains what kind of growth and how do we come back, or remain, within planetary limits. In developing countries such as Sierra Leone, roughly six million people lack access to energy, water, sanitation, shelter, food, clothing and transport. Without significant growth of goods and services, it is impossible to lift these people out of poverty. Although growth does not always translate into poverty reduction, poverty reduction is always associated with growth whichever the measure of poverty is used. Whereas in industrialized countries, consumption and production patterns are unsustainable, using considerable amounts of natural resources and with related negative environmental and sometimes social impacts. The green economy seeks to drive the growth of nations, especially developing and transitioning countries.

**Keywords:** Green economy, climate change, economic growth, poverty reduction, transitioning, ETC

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### 1. Introduction

Since the Industrial Revolution, the impacts of human behavior have had increasingly negative effects on the planet and its ability to continue providing a functioning environment for the various species making up its inhabitants, while at the same time bringing millions out of poverty, and supporting development, wellbeing and prosperity. This has been a major trade-off which is increasingly seen as not being sustainable given the impacts that risk undermining the progress made. This is particularly true given the rise of emerging economies with significant population sizes and a growing global population leading to a subsequent increased demand for resources within a more resource constrained world. In 2007, the Intergovernmental Panel on Climate Change (IPCC) published its 4th Assessment Report in which it identified that unmitigated climate change was likely in the long term to exceed the capacities of natural, managed and human systems to adapt. Climate change mitigation activities will need to continue to be developed in order to achieve lower stabilization levels of atmospheric CO<sub>2</sub>. The crisis of biodiversity loss has also become increasingly evident in recent years. The Millennium Ecosystem Assessment (MA) assessed the consequences of ecosystem change for human well-being. Published in 2005, the headline results were that 60% of the world’s ecosystems were in a degraded state, putting in question their continuing functioning or existence.

In other words, development was far from being sustainable. Following on from the MA, another international study on the Economics of Ecosystems and Biodiversity (TEEB) was launched in 2007. TEEB aimed “to draw attention to the global economic benefits of biodiversity, to highlight the growing costs of biodiversity loss and ecosystem degradation, and to draw together expertise from the fields of science, economics and policy to enable practical actions moving forward.” In addition to climate change and biodiversity loss, human over-exploitation of natural resources is also resulting in the breaching of some natural thresholds.

These days climate change is the foremost sensitive subject in the energy sector that we should focus on it. It is the increase in the average temperature of the climate of Earth a long time ago and continuous until now and it is a portion of climate change. Actually, our planet's climate changes over the geological time when significant fluctuations in the average temperatures but although the temperatures increase more than any time before. It has become evident that humankind is responsible for most of the warming in the past century by causing greenhouse gases. We are doing this by burning fossil fuels, agriculture, land use, and other activities that drive climate change. This rapid rise in temperature is a problem because it is changing our climate at a very rapid rate for living things that they cannot adapt to. Climate change is not only related to high temperatures, but also includes extreme weather events, rising sea levels, changing populations of wildlife, habitats and plants, and a host of other impacts <sup>[1]</sup>. The expression “Global Warming” called by Wally Broacher and he used it in 1975. Human carries responsibility for the climate change containing ocean heat, deposition, 90% of global warming happens in the oceans. The average temperature has raised a 0.75 Celsius degree. Also, scientists over the past years noticed that global temperatures have raised by 1.3 Celsius degree which is too much. The proof of global warming is clearly incredible in the recent melting of ice sheets. The Intergovernmental Panel on Climate Change (IPCC) said that we need to keep global warming below 1.5 Celsius degree to avert any irreversible influence. In the 1990s, 165 countries signed an international treaty, the United Nations Framework Convention on Climate Change. These countries have held annual meetings since then (in the name of the "Conference of the Parties"), to develop goals and methods to reduce climate change, as well as to adapt to its already visible impacts. Today, 197 countries are bound by the United Nations Framework Convention on climate change.

### 1.1 Research and data analysis of climate change

- As per the U.S. Geological Survey, Previously there were 150 glaciers existed in Montana's Glacier National Park but on account of global warming and the increase of the temperature remains only 25 glaciers out of 150. Also, because of global warming Tornadoes and storms become more intense.
- The United States information and referral center in support of polar and cryospheric research that is called the National Snow and Ice Data Center (NSIDC) said It is clear that global climate change temperatures establish and intensify the likelihood of severe humanitarian effects of natural disasters. Researchers generally accept

that global warming di-rection significantly increases the likelihood of more frequent, more serious natural disasters.

- The National Aeronautics and Space Administration (NASA) made two studies and they compared Earth temperature data for 2019 with historical record data compiled by scientists, which began recording in 1880. Of these past 140 years, 2016 was the hottest year ever recorded, followed by 2019; analyzes also show that the five most The hottest year was five years from 2015.
- According to IPCC Antarctica and Greenland are losing ice six times faster than they were in the 1990s. According to the global team of climate scientists after the research, the unprecedented rise in the rate of melting has contributed to sea-level rise to 0.7 inches which equals 1.78 cm in the past three decades, putting the planet on the track for the worst case of the global warming scenario stipulated in the last report developed by IPCC <sup>[2]</sup>.

### 2. Causes of Climate Change

The primary cause of climate change is greenhouse gases (GHGs) they absorb and emit infrared radiation to Earth which are carbon dioxide, nitrous oxides, methane, chlorine, and bromine-containing compounds. They are trace gases and they are almost one-tenth of 1% of Earth's atmosphere. Several reasons cause global warming which are the changes in the Earth's orbit around the sun: As a result of the change in the amount of solar radiation that reaches the Earth, volcanic eruptions because volcanic eruptions cause large amounts of gases and dust, and sulfur dioxide emitted from these gasses and its negative impact is that they remain in the atmosphere for long periods of time, and therefore the radiation of the sun is plugged, while the minutes of the dust emitted impact the balance the atmosphere raises, the temperature of the Earth, and the emissions from organic pollutants. Another cause of global warming is ozone depletion where is the definition of the ozone layer is a layer that exists in the atmosphere and contains ozone gas which protects the Earth from harmful ultraviolet (UV) rays from the sun. An important cause of global warming is the attrition of this layer. Gasses from industries, including chlorofluorocarbons (CFCs) are causing holes in the ozone layer so harmful gasses enter the Earth through these holes, leading to clogging and global warming and the use of chemical fertilizers where chemical fertilizers are considered one of the most influencing factors in the greenhouse effect, because they contain many compounds that contribute to the phenomenon of greenhouse gases, such as nitrogen oxides, which cause many holes in the ozone layer, and therefore the UV rays Harmful enters the earth through these holes the temperature rises. Another cause of global is the Aerosols that exist in the atmosphere layer it changes the climate in two different ways. The first way that solar and infrared radiation has been absorbed wasted, the second one they modify the clouds' properties and influence their range and lifetime <sup>[3]</sup>. The purpose of the scattering of solar radiation is to make the planet cooler when the absorption by aerosols makes the air warmer. Aerosols are known to increase radiation at longer wavelengths and to reduce radiation at shorter wavelengths. The strength of these effects depends on the size of the aerosol molecules and their chemical nature. The scientific community said to be less important the climate is more sensitive than that of the short wave effect <sup>[4]</sup>.

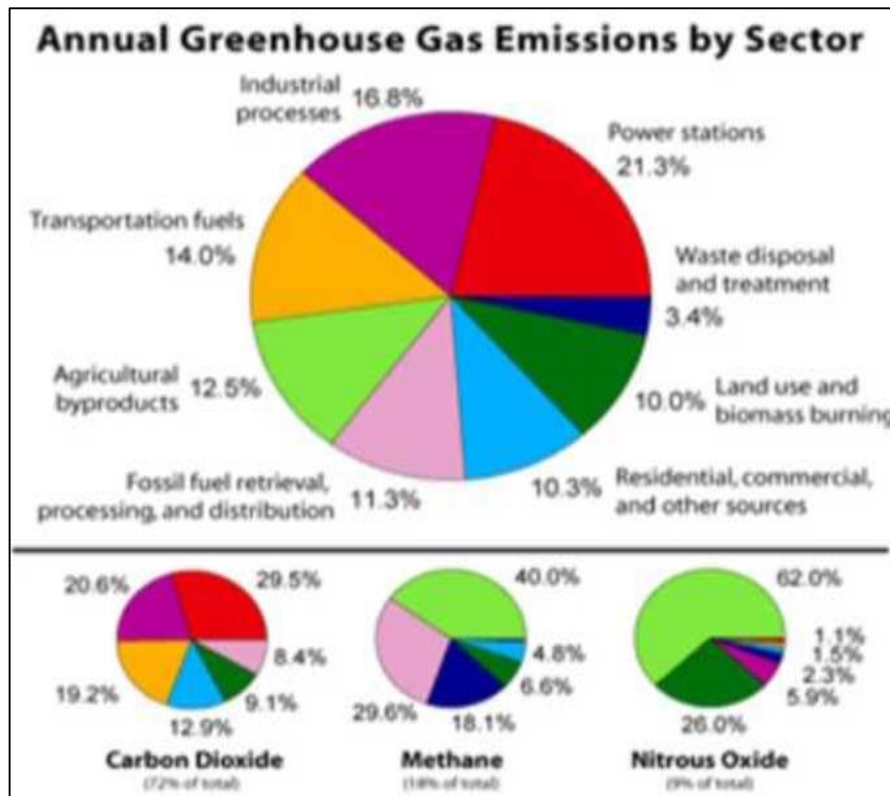


Fig 1: Greenhouse gases' distribution [5].

**2.1 Greenhouse Effect**

Climate change's impacts on the environment wide and far-reaching. They affect ice, oceans, and the weather and may happen quickly. The temperature of the Earth completely depends on the function of the atmosphere layer. The range of cooling and heating Affected by different factors [6]. Climate change is a phenomenon resulting from the emissions of some greenhouse gases, such as methane, carbon dioxide, and some nitrous oxides, and these gases are present in natural proportions in the atmosphere surrounding the earth and their presence is necessary to make life possible on the surface of the earth. Previously there was a reason for increased levels of the presence of these gases in the atmosphere, which negatively affected the Earth's temperature and made it increase. The most significant aspect is the type of surface in the

atmospheric greenhouse effect where sunlight first occurs-stances are the most paramount factor. Ocean surfaces, grasslands, ice caps, deserts, forests, and cities all absorb, mirror, and even radiate radiation. The falling of sunlight that strikes white glacier surface mirrors roughly to space which leads to the lower atmosphere and the reduced surface warming. The Earth absorbs the sun's heat and naturally radiates the same amount of heat that is absorbed so that the Earth remains at a constant temperature. However, the presence of greenhouse gases in increasing proportions than normal in the atmosphere made it prevent part of the heat emitted from the Earth and reflected on the planet, which increased the air temperature Touches the ground and hence the temperature increases and hence these gases are called greenhouse gases [7].

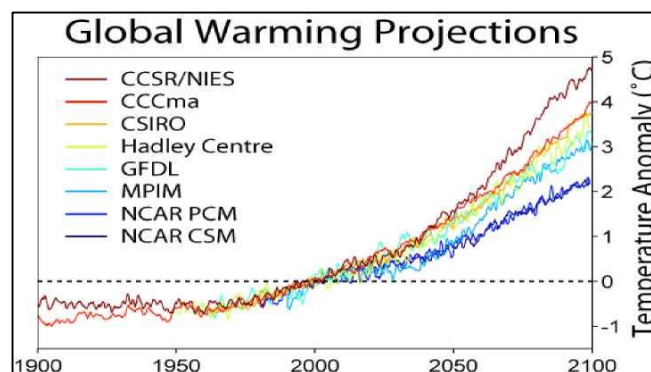


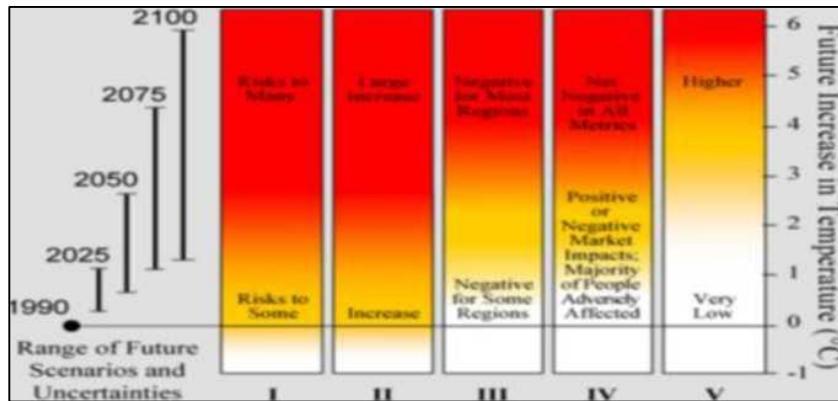
Fig 2: Projections of global warming [8].

Figure 2 shows the expected risks of global warming in net following years based on previous data. This can be cleared in the figure, We are witnesses of natural crises like flooding, thunderstorms, and earthquake in the shape of sharp climate

events that will happen if we continue on this pattern. There will be a sharp rise to this demolition if no action is taken to avoid this problem. Currently, The estimations confirm that it becomes mandatory to decrease greenhouse gas emission

by more than 80 percent, especially in sophisticated countries over 2 Celsius degrees [9].  
 by 2050 to stay below the threshold annual temperature raise

**Risks and Impacts of Global Warming**

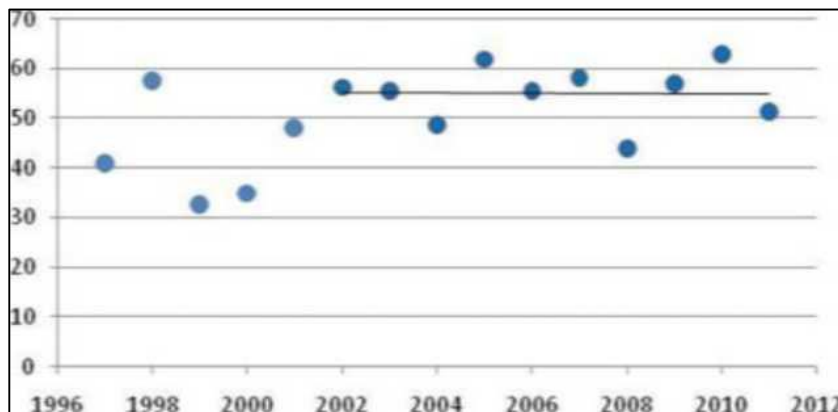


I Risks to Unique and Threatened Systems  
 II Frequency and Severity of Extreme Climate Events  
 III Global Distribution and Balance of Impacts  
 IV Total Economic and Ecological Impact  
 V Risk of Irreversible Large-Scale and Abrupt Transition

**Fig 3:** An appreciation of risks and effects related to global warming and divided into five groups. The bars have been coded by colors to distinguish the impact of each factor [8].

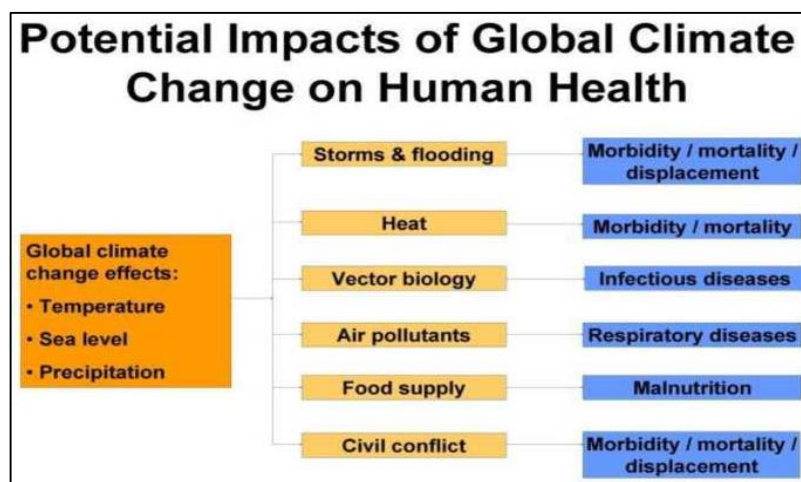
Figure 4 shows the mean of global temperature in recent years according to NASA.

**Recent Global Temps (Annual Means)**



**Fig 4:** Annual means of global temperatures [10].

Figure 5 displays the global climate change effect and how it affects temperature, sea level, and precipitation.



**Fig 5.** Potential impacts of global climate change on human health [11].

Global warming affects both humans and animals because animals also need a cooler place to live. The weakness of the atmosphere layer in his way to point without any recurrence and couldn't be as before from the point of view of several scientists [12]. To conclude the alternative that we have there three actions could be taken into account which are:

1. Living without doing anything.
2. Adapting to climate change which includes the environmental impacts mentioned before natural crises like flooding.
3. Reducing the effect of the greenhouse by reducing the concentration of carbon dioxide emissions [13].

**2.2 Solutions of global warming 1) Renewable energy**

Alternative solutions should be used and counting on it which is renewable energy sources. There are different renewable energy technologies can be used instead of fossil fuels depend on the country and its weather. The renewable energy sources are wind, solar, geothermal, ocean thermal and kinetic, hydrokinetic, biomass, and hydropower [14]. Furthermore, fossil fuels one day will finish soon or later so we have turned to renewable energy for energy production. Thus, the radical solution to save our planet and limit global warming is renewables.

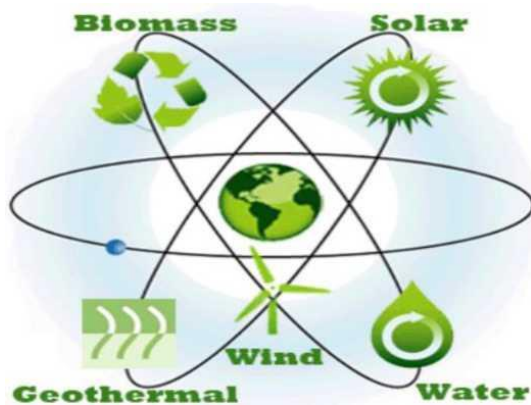


Fig 6: Sources of renewable energy [15].

Renewable energy is the energy generated from natural, unconventional and continuous sources that are endless. It is available all over the world and is clean and does not pollute the environment and maintains public health, as well as it is economic and has a great economic return. Renewable energy was available in some advanced industrial countries, and now it is spread in 164 countries around the world with policies and goals. When we look at investments compared to GDP, and the reason for this is that the cost of renewable energy production has decreased significantly.

The Paris Climate Change Agreement was a contributing factor in thinking about how to take urgent action to combat climate change and its impacts and reduce carbon emissions.

**World Fuel Consumption**

Table 1

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cn	CT)	cn	cn	Cn	Cn	cn	o			o	o	o	O	o
rd		rd	1	t-1	rH	rd		t-1	1		rH	tN		OJ (N)

We recognize that renewable energy is developing rapidly, and has been the focus of discussions at the Paris Climate Conference. What we expect after the Paris conference is an increase in investment orientation in this regard because what it means is that the world has agreed to remove carbon from the energy system by 2050. Everything in life has advantages and disadvantages so I clarified below the advantages and disadvantages of renewables in general.

The advantages of renewable energy are sustainable, cleaner than fossil fuels, it does not finish, onetime cost of installation, independent regarding prices of fossil fuels, maintains human health, reducing natural disasters protecting groundwater, seawater, rivers and fish resources from pollution, providing the basis for energy independence and extinction and It contributes to achieving food security.

The disadvantages of renewable energy are difficulty applying renewable energy commercially because many forms of renewable energy must be collected in a specific place, which means that distribution networks must be prepared to take advantage of the energy that can be generated, and these networks require a massive investment in the field of fuel, many forms of renewable energy are site-specific it is not available to every community to use, Forms of renewable energy require storage capabilities, The technologies and facilities used to build renewable energy resources require fossil fuel as well as transportation and distribution networks, and in many cases renewable energy depends on regular fuel and there are some forms demand a huge space to get the benefit from it [16].

Table 1: Emissions of carbon dioxide (g CO2/ kWh) of renewable technologies [17].

No.	Renewable Technology	Min. of CO2 emissions (g CO2 / kWh)	Max. of CO2 emissions (g CO2 / kWh)	Average value	Ranked value
1	Hydro	2	74.9	38.450	8.843
2	Wind	5.3	123.7	64.500	8.058
3	Geothermal	11	78	44.500	8.660
4	Solar PV	9.4	300	154.700	5.343
5	Biomass	14.4	650	332.200	0.000

For carbon dioxide (CO2) emission that is needed to be minimized:

$$\text{Ranki} = \frac{\text{Maximum-Methodi}}{* \text{IVlo}'\text{V}'\text{i}'\text{mn vn}'z} \times 10 \tag{1}$$

I ranked the renewable technologies in order to choose the optimum one that is suitable to the environment The maximum method that was selected is biomass technology because it has the highest rate of carbon dioxide emission (g CO2/ kWh), so the closest to the ideal case is 10 (minimum environmental impact) and the lowest overall performance is 0 (maximum environmental impact) as shown in Table 1. As per shown results, the closest to an ideal is Hydro technology.

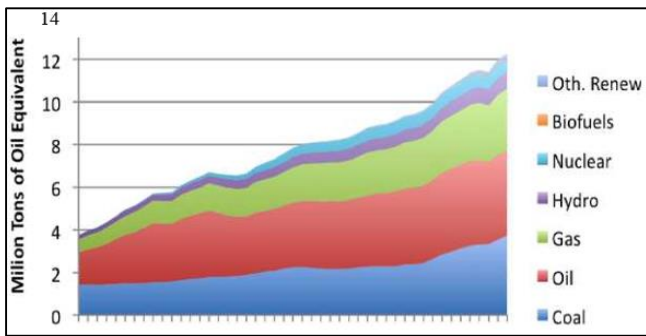


Fig 7: Recent years world fuel consumption [18].

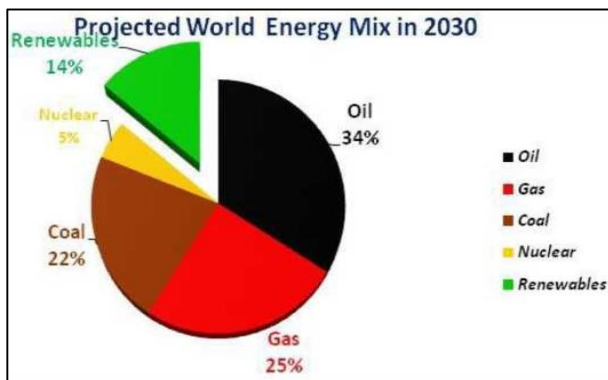


Fig 8: The planned world energy by 2030 [19].

## 2) Other solutions

There are different ways in order to reduce emissions of greenhouse gases in the atmosphere of Earth. Some techniques are useful to decrease greenhouse gases the first one is cheap compared to others which is the placement bioremediation in the biosphere layer of Earth. The purpose of it is to eliminate pollutants and wastes. The second one is phytoremediation which considered a very effective way to decrease the contaminants from the air, soil, and water. The third one is to use methanotrophic endophytes inhabiting *Sphagnum* spp which function is minimizing carbon dioxide and methane emissions up to 50% from lands that consisting largely of peat or peat bogs [6].

There are different ways also could be done from our side to reduce global warming like waste minimization by choosing reusable products and purchasing products with minimal packaging, reducing energy use in air conditioning with using insulation methods in walls, ceilings, doors, and windows, depending on other transportation which fewer carbon dioxide emissions, reliable walking, biking, and public transportation, planting trees: if there is suitable space around the house and replacing regular light bulbs with integrated fluorescent lights means less energy use. Also, we can decrease the usage of electrical power by unplugging unused devices and machines and using efficient electrical devices that consume less energy. Using less hot water when showering, or washing clothes helps to reduce the consumption of energy. The government should take action in order to preserve the environment by making penalties for people cutting down trees.

## 3. Conclusion

In the end, climate change is a major threat and effective action needs to be taken to address this important problem. This problem poses trouble not only to humans but to plants and animals as well. Climate change has already started to

affect our world in different ways than we might imagine.

In the solutions to global warming, I made a comparison between renewables to check which is better for the environment for which emit lower carbon dioxide and I found that hydro energy is the best. Saving the environment is our job and it is not volunteer work. We are responsible for that to take action versus these horrible alterations to make life clean and easier for the future generation and don't make harder for them to solve it. We should use tools and machines that are efficient in terms of energy. Also if the power plants begin to reduce to their energy that will help minimize greenhouse gases. We should cut down as much as possible in our houses and companies. We can help the environment also by using equipment that can be recycled and being friendly to the environment.

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