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A Review of the Effects of Global Warming: Internationally and on Caribbean States

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Abstract

Global warming (GW) is the continuing rise in the average temperature of Earth's Climate System. It is induced mainly by Greenhouse gases. Carbon dioxide (CO_2) causes 9-26% of GW, Methane (CH_4), from animal droppings and wetlands, as well as human activities such as rice cultivation causes 4-9% of GW. Ozone (O_3) causes 3-7% of GW. Nitrous Oxide, N_2O from fertilisers and from burning plants causes 1% of GW. Emissions of greenhouse gases grew 2.2% per year between 2000 and 2010, compared with 1.3% per year from 1970 to 2000. CO_2 is the largest main contributor of global warming. CO_2 traps heat and enters the atmosphere mainly from the burning of fossils fuels via industry, the use of vehicles, deforestation, and fires. The current worldwide status is that there is a chemical imbalance in the level of CO_2 in our International atmosphere which has resulted in Global warming. The carbon cycle is no longer a cycle. Global warming has manifested itself in the melting of ice caps, glaciers, rising sea levels, flooding, intense unseasonal rainfall, intense hurricanes, drought or periods of extremely dry weather, and higher heat index. The temperature of our planet has risen by 1-2◦C. In the Artic, ice is melting on land and at sea. The release of fresh water into the oceans has changed and will continue to change the course of currents that play a vital role in climate. The volume of water in the Caribbean seas have risen. Over the past 50 years, very hot days and nights are happening more often and very cold days and nights are happening less often. Periods of high temperatures (heat waves) have become longer and hotter over most land areas. Big storms with heavy winds and rain in the Caribbean are happening more often and causing more and more damage. Global warming has caused havoc on Caribbean infrastructure, affected agriculture production and productivity and the livelihood of many in the Caribbean States. There is an urgent need to prevent GW via further Universal protocols/treaties and individual practices to save the Caribbean and the rest of the world.

Keywords: *Global warming, Greenhouse gases, carbon dioxide, fossil fuels, deforestation, ice caps*

Introduction

Global warming (GW) is the continuing rise in the average temperature of Earth's Climate System. GW is also used to refer to increases in average temperature of the air and sea at Earth's surface. Since 1971, 90% of the warming has occurred in the oceans. Since 1978, output from the Sun which has been measured by satellites has not increased since then. Hence, the warming during the past 30 years cannot be attributed to an increase in solar energy reaching the Earth but "Global Warming" (Church and White, 2006).

GW is induced mainly by Greenhouse gases such as carbon dioxide, methane, and nitrous oxide. Carbon dioxide (CO_2), causes 9-26% of GW. Methane (CH_4), from animal droppings and wetlands, as well as human activities such as rice cultivation causes 4-9% of GW. Ozone (O_3) causes 3-7% of GW. Nitrous Oxide, N_2O which originates from fertilizers and also from burning plants causes 1% of GW. Emissions of greenhouse gases grew 2.2% per year between 2000 and 2010, compared with 1.3% per year from 1970 to 2000 due to increase

anthropogenic activity. CO_2 is the largest contributor to global warming. CO_2 traps heat even though it's a natural component of the atmosphere. CO_2 enters the atmosphere mainly from the burning of fossils fuels via industry, the use of vehicles, deforestation, and fires. The current worldwide status is that there is a chemical imbalance in the level of CO_2 in our International atmosphere which has resulted in Global warming. Carbon is not sequestrated as it emitted. The carbon cycle as depicted in Figure 1 is no longer a cycle. The Caribbean has been experiencing an increase in global warming and climate change. The Intergovernmental Panel on Climate Change (IPCC) in 2007 reported that more than 90% of global warming was caused by increasing concentrations of greenhouse gases (GHGs) produced by human activities (Harvey *et al*., 2009, Solomon *et al*., 2009; NASA, 2023).

Vehicles (e.g., cars, machines, etc.) and industries such as mining or manufacturing use fossil fuels. Electricity is often produced by burning fossil fuels such as coal or natural gas. These fuels all contain high amounts of carbon. The combustion of these fuel produces CO_2 that goes into the atmosphere. Fossil fuel burning has produced about three-quarters of the increase in CO_2 from human activity over the past 20 years. Coal burning has been responsible for 43% of the total emissions, oil 34%, gas 18%, cement 4.9% and gas flaring 0.7%. In May 2013, it was reported that readings for CO_2 taken at the world's primary benchmark site in Mauna Loa surpassed 400 ppm. This is the first time CO_2 levels have been this high for about 4.5 million years. Deforestation which involves the cutting down or burning trees to change forests into pastures or agricultural land or for commercial timber production, releases more CO_2 into the atmosphere and decreases carbon storage. Degradation reduces the number of trees and the stock of carbon in a specific forest area. Hence, deforestation and degradation are contributor to GW. Deforestation also removes biodiversity and affects other ecosystems as well.

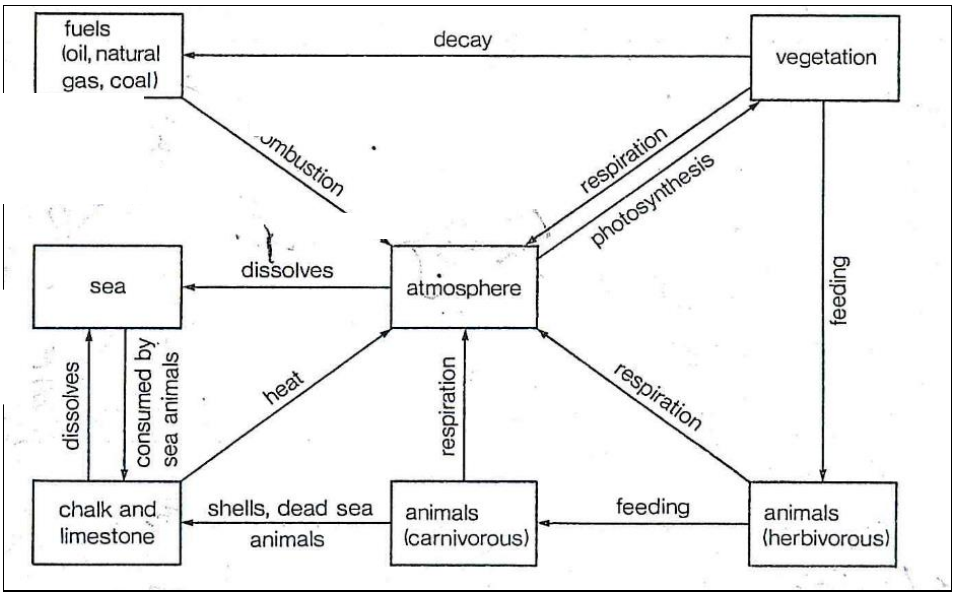

Figure 1. The Historical Carbon Cycle

Land use Change is also responsible to alter CO_2 in the atmosphere. When forests are cut down for commercial timber, agriculture or livestock grazing, the amount of forest available as a CO_2 sink is reduced, so more CO_2 stays in the atmosphere. This results in a change from an area of high carbon storage to one of lower carbon storage (von Deimling and Ganopolski, 2006). The objectives of this paper are to review the effects of Global warming internationally and on Caribbean States and measures that have been taken to curb global warming.

Effects of Global warming internationally and on Caribbean States

Global warming has manifested itself in the melting of ice caps, glaciers, rising sea levels, flooding, intense unseasonal rainfall, intense hurricanes, drought or periods of extremely dry weather, higher heat index etc. The temperature of our planet has risen by 1-2◦C. The artic is warming several times faster than most of the planet. Ice is melting on land and at sea and the release of fresh water into the oceans has changed and will continue to change the course of currents that play a vital role in climate. The volume of water in oceans have risen. Temperature changes vary over the globe. Since 1979, land temperatures have increased about twice as fast as ocean temperatures (0.25 °C per decade against 0.13 °C per decade). Ocean temperatures have also increased more slowly than land temperatures, because of the larger effective heat capacity of the oceans and because the ocean loses more heat by evaporation. The Northern hemisphere is also naturally warmer than the southern hemisphere.

While some regions are receiving less rainfall and suffering longer and more droughts, other regions of the world are experiencing much higher level of rainfall. In many places, the seasons of times of year when rain falls are changing. Rain is falling at different times and for shorter or longer periods than in the past. At the earth's poles, more and more of the ice caps/ glaciers are melting because of global warming. The artic is warming several times faster than most of the planet. Ice is melting on land and at sea. Satellite data imagining shows the perennial ice cover has decreased by 9% over the decade.

Over the past 50 years, very hot days and nights are occurring more often and very cold days and nights are occurring less often. Periods of high temperatures (heat waves) have become longer and hotter over most land areas. Currently, countries in the Caribbean such as Guyana have been experiencing heat waves. Big storms with heavy winds and rain are occurring more often and causing more havoc. In the last 100 years, the average global sea level has risen about 6 inches or 15 centimetres. This will certainly further affect Caribbean States that are low lying like Guyana. It will cause flooding. Sea levels are rising because warmer ocean temperatures cause the oceans to expand. Also, melting of the ice caps/glaciers has increased the volume of H_2O in the ocean (Stone and Leon, 2010).

GW has also been responsible for serious intense catastrophic hurricanes and flooding in the Caribbean. The intensity and strength of the hurricane seems to increase every year, reaching its way to the United States, where it also causes havoc. Several intense regular hurricanes recently have seriously affected lives in the Caribbean and the USA because of GW. Some of these are discussed below.

Hurricane Beryl, a Category 5, was a deadly and destructive hurricane that impacted parts of the Caribbean, the Yucatán Peninsula, and the Gulf Coast of the United States in late June and early July 2024. It was the earliest-forming Category 5 hurricane on record. Beryl was also the strongest hurricane to develop within the Main Development Region (MDR) of the Atlantic before the month of July, 2024. 70 persons died. The total damage was estimated to be greater than $6.86 billion (2024 USD). Areas affected in the Caribbean were: Barbados, Windward Islands (especially Grenada and St. Vincent and the Grenadines)Trinidad and Tobago, Venezuela, Hispaniola, Jamaica, Cayman Islands, Yucatán, Peninsula, Belize, United States (mainly Texas and Louisiana, the Ohio Valley and the Lower Peninsula of Michigan)Eastern Canada (mainly Ontario, Quebec, and Nova Scotia)

Hurricane Ivan, a Category-5 hurricane which devastated 90% of Grenada in 2004 affected lives in Florida in 2004. It also caused catastrophic damage in Grenada, Jamaica, Grand and Cayman Island (Stewart, 2005). Hurricane Matthew in 2007 was an extremely powerful Atlantic hurricane which induced catastrophic damage and a humanitarian crisis in Haiti, as well as widespread devastation in the southeastern United States. It was the deadliest Atlantic hurricane since Hurricane Stan in 2005, and the first Category-5 Atlantic hurricane since Felix in 2007. Matthew was the second major hurricane of the 2016 Atlantic hurricane season. It caused extensive damage to landmasses in the Greater Antilles, and severe damage in several islands of the Bahamas (Stewart, 2017).

Hurricane Dorian in September 2019 was an extremely powerful and catastrophic Category 5 Atlantic hurricane. It became the most intense tropical cyclone on record to strike the Bahamas. It was the worst natural disaster in the Bahamas' recorded history. It was one of the most powerful hurricanes in the Caribbean, since Wilma in 2005, in terms of sustained winds, with winds peaking at 185 mph (295 km/h). At least 44 people died when Hurricane Dorian hit the Bahamas. It flattened homes, tossing cars and planes like toys. There was severe destruction of infrastructure on the greater Abaco Island of the Bahamas (The Guardian, 2019).

Hurricane Sandy, October 2012 (also known as Superstorm Sandy) was an extremely destructive and strong Atlantic hurricane. It was the largest Atlantic hurricane on record as measured by diameter, with tropical-storm-force winds spanning 1,150 miles (1,850 km). The storm inflicted nearly $70 billion (2012 USD) in damage and killed 233 people across eight countries from the Caribbean to Canada. The eighteenth named storm, tenth hurricane, and second major hurricane of the 2012 Atlantic hurricane season, Sandy was a Category-3 storm at its peak intensity when it made landfall in Cuba, though most of the damage it caused was after it became a Category 1-equivalent extratropical cyclone off the coast of the Northeastern United States (Sheppard, 2014; Zerkel, 2014; RMS, 2020). Joaquin acquired sustained winds of 155 mph (250 km/h), just short of Category 5 strength.

Hurricane Joaquin, 2015 was a powerful tropical cyclone that devastated several districts of the Bahamas, Turks and Caicos Islands, parts of the Greater Antilles, and Bermuda. It was also the strongest Atlantic hurricane of non-tropical origin recorded in the satellite era (NHC, 2015; Berg, 2016).

Hurricane Wilma was the most intense tropical hurricane ever recorded in the Atlantic basin, and the second-most intense tropical cyclone recorded in the Western Hemisphere, after Hurricane Patricia in 2015. Category-5 hurricane, reaching 185 mph. Jamaica, Puerto Rico, Cuba, Cayman Islands, Central America, Mexico (especially Quintana Roo), United States (especially Florida), Bahamas, Bermuda, Nova Scotia, Saint Pierre, and Miquelon were all affected with damages to infrastructure. Damages were estimated to be $22.4 billion (2005 USD) with fatalities 52 (Pasch et al., 2006). Table 1 shows a list of some catastrophic hurricanes in the Caribbean, since 2000.

Table 1. Some Catastrophic hurricanes in the Caribbean

Name of hurricane	Year	Speed	Effects on humanity
Berryl	2024	Category 5	Beryl caused catastrophic damage on Grenada's northern islands of Carriacou and Petite Martinique and on several of Saint Vincent and the Grenadines' southern islands, such as Union Island and Canouan. In Venezuela, six people were killed and one person went missing as a result of the storm. In the United States, the state of Texas experienced severe flooding and wind damage, with reports of at least 36 dead in the Houston region. Damages estimated to be greater than 6.86 Billion USD.
Ivan,	2004	Category 5	Catastrophic damages in Grenada, Jamaica, Grand and Cayman Island
Matthew	2016	Category 5 (165 mph 270 km/h)	Extreme damage to landmasses in the Greater Antilles and islands of Bahamas. 603 total fatalities. $16.5 billion (2016 USD) loss in infrastructure
Sandy	2012	Category 3. Tropical-storm-force winds spanning 1,150 miles (1,850 km).	The storm inflicted nearly $70 billion (2012 USD) in damage and killed 233 people across eight countries from the Caribbean to Canada
Joaquin	2015	Category 4, 155 MPH	Devastated several districts of the Bahamas, Turks and Caicos Islands, parts of the Greater Antilles, and Bermuda. 34 fatalities were reported with damage of 200 million USD
Wilma	2005	Category 5 hurricane, reaching 185 mph	Devastated several districts of islands Jamaica, Puerto Rico, Cuba, Cayman Islands, Central America, Mexico (especially Quintana Roo), United States (especially Florida), Bahamas, Bermuda, Nova Scotia, Saint Pierre and Miquelon. 52 fatalities. 22.4 billion loss in property

Guyana and Venezuela experienced unexpected intense flooding in 2005, another manifestation of GW. Also, the flooding experienced in New Orleans, Louisiana, United States of America (USA) in 2005. The 2005 Georgetown flood also called the Great Flood was a major flood in and around Georgetown, the capital city of Guyana. It started with heavy rains in 2004, and peak in January 2005. Sustained heavy rains and high tides devastated the deteriorating water conservancy. Approximately 290,000 people (39% of Guyana's population) were affected, and the economic impact was estimated to be about US$ 465 million, or 59% of Guyana's gross domestic product (GPD) (GFDRR, 2016). A total of 34 lives were lost during the flooding. Seven persons died by downing and the rest died, resulting from illness from the flood. Property damage was estimated to be US$500,000,000 (Stabroek News, 2020).

Climate change also has had a significant impact on the Small Island Developing States (SIDS) of the Caribbean, affecting food production and food availability in the Caribbean i.e., food security. These events have manifested itself in significant losses in agricultural production (both crop and livestock), necessitating the importation of food and the provision of financial aids to affected islands of the region. For example, Dominica suffered a loss of US $1.3 billion because of Hurricane Maria in 2017, accounting for 226% of the national GDP. This has led to a dramatic decline in fiscal performance and increasing external debt (IMF, 2018). According to Tiedmann *et al*. (2021), achieving sustainable development goals, including zero hunger in SIDS correlates with building climate resilience. Climate change devastating effects on food security are compounded by other challenges such as shifting production practices, population growth, urbanization, new attitudes to diets, imported foods, price volatilities, deteriorating trade terms, inefficient marketing practices, the shift towards a corporate food regime and a decline in conservation practices (Connell, 2015). During and after disaster, persons are at a higher risk of contracting food borne disease. Global warming has also resulted in loss of flora and fauna diversity of the Caribbean region and the rest of the world.

Measures taken to prevent global warming, internationally and in the Caribbean

There is an urgent international need to curb GW via the reduction in the level of CO_2 and other Greenhouse gases. CO_2 in the atmosphere is the biggest source of Global warming and climate change. CO_2 emissions would need to be reduced by more than 80% relative to the peak level. There is need to burn less fossil fuel via the use of renewable energy such as bioethanol. Bioethanol plants have been established in Guyana, Trinidad, Jamaica, and other small island states of the Caribbean. In Guyana, the first bioethanol plant was established at Albion, Guyana in 2013. This plant uses black strap molasses

as its feedstock and is designed to produce 99.6% ethanol (CEIS, 2013). There is a need to use cars less and public transportation more, e.g., using smaller vehicles to reduce fuel consumption and reduction in CO_2 output from combustion. Reforestation and forest degradation. Improved crop and pasture management to increase carbon storage in the soil. Use more efficient electrical equipment like solar panels to provide electricity to communities. The use of renewable energy in place of fossil fuels should be intensified. Reforestation will add new trees to remove carbon from the air and improves carbon storage. Reforestation maintains or increases the number of trees and the stock of carbon in a specific forest area. Hence, an increase in carbon credits.

In 1992, a body of framework within the United Nations, the United Nations Framework Convention on Climate Change (UNFCCC) was established. The main objective has been to propose and implement climate change policies. Several protocols, under UNFCCC have been established, since 1992 to curb global warming and climate change. Amongst these were the Kyoto Protocol (1997), Bali Accord (2007), Copenhagen Accord (2009), REDD+ Paris Accord (2017). The Kyoto Protocol has been the most important agreement made by UNFCCC to date. Reduction of the amount of CO_2 and other gases released into the atmosphere. In addition, there is a need to seek alternative renewable energy that causes less CO_2 emissions. There is an urgent need to stop deforestation, improving forest management and forest conservation. There is also a need to protect communities from rising sea levels and creating national adaptation plans. There is also a need to find ways to provide expertise, technology, and funds to pay for these actions. Developed countries have agreed to transfer technology and funds to developing countries to assist them to help curtail global warming/ climate change and to adapt to the changes they are seeing now and in the future. This was adopted at the UNFCCC meeting in Bali, Indonesia. Countries agreed to a course of action for a new negotiating process to tackle climate change. The goal was to make decisions on what would be included in a new agreement after the Kyoto protocol. This accord discusses several important points for future agreements. These include commitments to reduce emissions and long-term funding plans for supporting action to mitigate climate change. This was a step toward reaching agreement at the next annual UNFCCC meeting in Mexico in 2010 (Stone & Leon, 2010).

The Paris Agreement, Paris Climate Accord, or Paris Climate Agreement is an agreement within the UNFCCC dealing with greenhouse gas emissions, mitigation, adaptation, and finance which commenced in 2020. The agreement was negotiated by representatives of 196 parties at the 21st Conference of the Parties of the UNFCCC in Paris and adopted by consensus on 12 December 2015. As of July 2017, 195 UNFCCC members have signed the agreement, 154 of which have ratified it. In the Paris Agreement, each country determines, plans, and regularly reports its own contribution it should make to mitigate global warming. There is no mechanism to force a country to set a specific target by a specific date, but each target should go beyond previously set targets. In 2017, President Donald Trump withdrew the USA from the agreement, causing widespread condemnation in the European Union and many sectors in the USA. The USA have been experiencing the effect of global warming in intense hurricanes destroying infrastructure, flooding in several states such as Florida, Miami, South and North Carolina and some parts of New York. In July 2017, France's environment minister Nicolas Hulot announced France's five-year plan to ban all petrol and diesel vehicles by 2040 as part of the Paris Agreement. Hulot also stated that France would no longer use coal to produce electricity after 2022 and that up to €4billion will be invested in boosting energy efficiency.

Previous Protocols such as the Kyoto and Montreal under the UNFCCC were not followed seriously. Kyoto Protocol: 1997-2012. The Kyoto Protocol was Superseded by the REDD+ protocol. The REDD+ protocol was implemented through the years 2005-2009. The REDD+ is an international payment policy for ecosystem services. Meetings were held through 2005-2009 (Montreal, Canada in 2005; Bali, Indonesia in 2007; Denmark, Copenhagen in 2009). Financial benefits can be provided to countries with large tropical forests that are able to reduce the amount of GHG release into the atmosphere by reducing the cutting of forests and reducing emissions from degradation. Countries like Guyana which have much of its forests intact, financial benefits may come from keeping these forests standing and continuing to store carbon. Guyana has received money from Norway as we have embarked on deforestation and forest degradation. For countries with high rates of deforestation, financial benefits could be paid for stopping deforestation practises and restoring degraded forests (Sone & Leon, 2010).

COP28 in 2023, was another international forum to address Climate Change. It was the biggest climate change conference and clearly indicated the desire and wishes of government and non-government organisation to accelerate the transition from fossil fuels to renewables such as wind and solar power etc (COP 28). It was the consensus at the conference that enough wasn't done since the Paris agreement to accelerate the transition from fossil fuels to renewables and much more needed to be done. Amongst the highlights of COP28 were:

1. Signalling the beginning of the end for the fossil fuel era.
2. There should be new funding for loss and damages
3. Global efforts need to be enhanced in order to strengthen resilience
4. There must be linking of climate action with nature conservation
5. Ramping up of real world climate solutions

SIDS need an holistic effort to rebound from Climate Change disaster. There should be an increase in human capacities via an improvement of education in all fields and health sectors. Reputable universities that are accredited should be on the agenda in order to ensure that citizens are provided with an high quality education. Citizens must be well educated

to deal with these disasters and be innovative enough to deal with smart agriculture practises such as the development of strong resistant crops to combat climate change and be engaged in innovative research. Science and technology should proliferate in these regions. Added to this, each island should have a task force at hand to deal with immediate climate disaster.

This include the formation of an International Caribbean Diaspora Committee on Anti-global warming which can strongly petition against countries via the United Nations to forcibly ensure that Protocols such as the Kyoto and Montreal, under the UNFCCC be followed seriously. Also, to ensure that the CO_2 level and other Greenhouse gases, GHGs is below the threshold limit. Eminent member of the Committee on Climate Change can visit the Caribbean yearly to give lectures and update on the progress of the Committee. In addition, to meet with the President and Government ministers to render advice on GW. Policies such as reforestation, sustainable forest management, the use of renewable energy in place of fossil fuels should be intensified. Significant improvement in the sea defence infrastructure should become a reality for Guyana and SIDS, considering rising sea level. Mangrove restoration should be intensified.

The committee should also endeavour to secure financial aid via international bodies and their own for fellow Caribbean countries in wake of natural disasters such as hurricanes and flooding that results from GW. Research in renewable energy, measuring the CO_2 sequestrating abilities of plants should be intensified at the universities. Research in renewable energy should intensify in the Caribbean. The Universities around the globe, including those in the Caribbean have MSc and PhD programmes in renewable energy. Various researchers have been pursuing renewable energy research projects programmes at the University of Guyana. Guyana has set up its first bio-ethanol plant at Albion estate on the Corentyne of Guyana. The Caribbean should follow Brazil in the use of C_{10} fuels use in the automotive industry.

Conclusion

GW affects the entire world of which the Caribbean is of no exception. Small Island Developing States (SIDS) are the more vulnerable. It has resulted in more forceful hurricane, whose migratory path have been also affecting the USA as well. It has caused havoc in the Caribbean, USA etc. destroying infrastructure, and causing fatalities. GW has affected the food security in the region. Protocols have been set in place to reduce global warming, and it is important that regional governments via the Caribbean Community (CARICOM) take a strong lead at the international forum to prevent or reduce GW significantly. These efforts should centred on the proliferation of renewable energy via solar farms, gas-alcohol production from lignocellulosic materials, sugar rich substrates and molasses. The use of shade houses should aid in food security in the region. The Caribbean should transition to the use of gas-alcohols as a fuel to power automobiles. It is predicted that the temperature of the earth will rise to 6◦C in the next century if global warming is not prevented and that will be more catastrophic. The transition from fossil fuels to renewables should accelerate to curb global warming. International organisations such as United Nations, UNESCO, Royal Society of Chemistry, International Science Council, International Academy of Partnership (IAP) should give strong support to ensure that net zero emission of CO_2 is achieved as soon as possible rather than by 2050.

References

1. Berg, R. (2016), "Tropical Cyclone Report: Hurricane Joaquin 2015 (Technical report)", United States National Hurricane Center, January 12, Retrieved May 17, 2017.
2. Bucci, Lisa (June 25, 2024). Tropical Weather Outlook (Report). Miami, Florida: National Hurricane Center. Archived from the original on June 26, 2024. Retrieved June 26, 2024
3. CEIS (2013), "First Ethanol Plant Commissioned in Guyana", Caribbean Information Systems, September 2, https://www.ceis-caribenergy.org/first-ethanol-plant-commissioned-in-guyana/#:~:text=The%20first%20ever%20biofuel%20ethanol%20plant%20in%20Guyana,which%20includes%20moving%20towards%20a%2010%25%20ethanol%20blend.).
4. Church, J.A., and White, N.J. (2006), "A 20th century acceleration in global sea level rise", *Geophysical Research Letters*, 33, 1602.
5. Connell, J. (2015), "Food security in the island Pacific: is Micronesia as far away as ever?", *Regional Environmental Change*, 15, 1299-1311, https://doi.org/10.1007/s10113-014-0696-7
6. GFDRR (2020), "Building Data, Knowledge and Capacity for Catastrophic Flood Prevention in Guyana," Global Facility for Disaster Reduction and Recovery (GFDRR), World Bank Headquarters, www.gfdrr.org. Retrieved 2020-12-20.
7. Harvey, C.A., Zerbock, O., Phillipsborn, J., Papageorgiou, S., Para, A., and Chacon, M. (2009), *Climate Change Training Materials*, Climate Change Initiatives Program, Conservation International, Arlington, VA.
8. IMF (2018), "Dominican Republic: 2018 Article IV Consultation-Press Release and Staff Report", *International Monetary Fund Staff Country Reports*, 18, 1.
9. NASA (2023), "Datasets and Images", National Aeronautics and Space Administration, Goddard Institute for Space Studies http://data.giss.nasa.gov/;
10. NHC (2015), "Atlantic Basin Storm Name Pronunciations: 2015-2020", National Hurricane Center. Miami, Florida, Archived from the original (PDF) on December 20, 2015. Retrieved October 1, 2015.
11. COP28: What was Achieved and What Happens. Retrieved from https://unfccc.int/cop28/5-key-takeaways, 13th/Jan/2024.
12. Pasch, R.J., Blake, E.S., Cobb, H.D., and Roberts, D.P. (2006), "Hurricane Wilma Tropical Cyclone Report",

National Hurricane Center. January 12, Retrieved May 7, 2010.

13. RMS (2013), "Modelling Sandy: A High-Resolution Approach to Storm Surge", Risk Management Solutions, Inc. October, https://forms2.rms.com/rs/729-DJX-565/images/tc_2013_rms_modeling_sandy_storm_surge.pdf
14. Sheppard, K. (2014), "Report Warns That Superstorm Sandy Was Not 'The Big One'", *Huffington Post*, September 18, Retrieved April 18, 2017
15. Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, KB., Tignor, M., and Miller, H.L. (2007) (eds), *IPCC 2007. Climate Change 2007: The Physical Science Basis. IPCC Fourth Assessment Report (AR4). Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press
16. Stabroek News (2020), "Remembering the 'Great Flood' 15 years later", *Stabroek News*, 2020-02-03. Retrieved 2020-12-20
17. Stewart, S. (2005), "Hurricane Ivan Tropical Cyclone Report", National Hurricane Center. May 22, Retrieved August 20, 2010.
18. Stewart, S.R. (2017), "Tropical Cyclone Report: Hurricane Matthew (Technical report)', United States National Hurricane Center, April 3, Archived (PDF) from the original on April 5, 2017. Retrieved April 5, 2017.
19. Stone, S., and Leon, M.C. (2010), *Climate Change and the Role of Forests, A Community Manual*, Conservation International, March
20. The Guardian (2019), "Search for survivors of Hurricane Dorian continues in Bahamas", *The Guardian*, September 9, 2019. Retrieved September 11, 2019
21. Tiedmann, J., Piatkov, V., Prihardini, D., et al. (2021), "Meeting the sustainability development goals in small developing states with climate vulnerabilities: Cost and financing", International Monetary Fund, https://www.imf.org/en/Publications/WP/Issues/2021/03/05/
22. Von Deimling, T.S., and Ganopolski, R (2006), "Climate sensitivity estimated from ensemble simulations of glacial climate", *Climate Dynamics*, 27, (2-3), 149.
23. Zerkel, E. (2014), "Superstorm Sandy Anniversary: Remembering Hurricane Sandy Two Years Later", *The Weather Company*, October 29, Retrieved April 18, 2017

Fact-Check:

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