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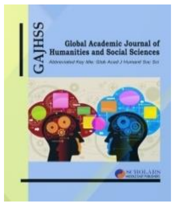

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Original Research Article

Sustainable Energy Solutions in Sub-Saharan Africa: Integrating Indigenous Knowledge and Climate Resilience for Lower Carbon Emissions

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Abstract: Promoting sustainable energy solutions in sub-Saharan countries is crucial for addressing energy poverty, reducing carbon emissions, and fostering long-term environmental and economic sustainability. This study explored using indigenous knowledge and emerging technologies to reduce carbon footprints and GHG emissions in Africa's climate hotspots in sub-Saharan countries. The study revealed that operating institutions utilize various applications to ensure that energy management resources can mitigate the effects of carbon emissions. The study revealed that the most efficient use of natural resources for energy production requires collaboration among governments, private sectors, NGOs, and local communities. By adopting a holistic and inclusive approach, one can work toward a more sustainable and low-carbon energy future. This paper focuses on carbon footprint analysis and proposes solutions to address environmental issues in implementing sustainable energy solutions in sub-Saharan countries. A multifaceted approach involving effective strategies is needed to lower the carbon footprint. The contribution of this study is to improve energy consumption in communities in Africa by integrating climate resilience considerations into sustainable energy projects to ensure long-term viability. This will involve planning for changing climate conditions, such as extreme weather events, and designing infrastructure that can withstand and adapt to these challenges. It has been concluded that carbon footprint analysis is useful for determining the impacts of carbon particles in the world's atmosphere. The role of energy management operations seeks to improve the assessment and analysis of carbon footprints by allowing atmospheric measurements of carbon.

Keywords: Indigenous Knowledge, Emerging Technologies, Carbon Footprints, GHG Emissions, Alternative Energy.

1. INTRODUCTION

Most sub-Saharan African (SSA) countries experience unreliable rainfall and prolonged droughts at catastrophic levels. Livestock production has significantly decreased due to the poor supply of fodder, feed, forage, and water, which has been exacerbated by the impacts of climate change Shao & Shen, 2017). This has implications for community development, environmental resilience, food/feed security, poverty, and conflicts between pastoral and farmer communities in terms of land use, water availability, supply, and distribution(Cole & Ellen, 2015). Most farmers in SSA rely on indigenous knowledge to adapt to and mitigate climate change impacts but lack the technological capacity to cascade indigenous knowledge to leverage emerging and reemerging catastrophes Shao & Shen, 2017). By integrating technology with indigenous knowledge, this project seeks to transform livestock systems for equitable water supply and climate data and achieve sustainable forage/rangeland management to reduce conflicts and increase pastoral communities' capacity to adapt to and mitigate the impacts of climate change. This goal will be achieved using emerging technologies in artificial intelligence and citizen science.

The amount of carbon dioxide emitted by industries worldwide is growing annually. This chemical particle is the most associated chemical particle that impacts the air quality of the world's atmosphere. There are new installations in all corners of the world (Cole & Ellen, 2015). This is why this paper targets discourse carbon footprint analysis as a tool for energy management for third parties who monitor carbon levels in the Earth's atmosphere daily. The study pursues determining the impacts that are caused by the growing amount of carbon emissions impacting society. Carbon footprint analysis is an important tool because the world community has been experiencing a transition from having good air quality to bad air quality due to carbon emissions. This is why carbon footprinting is important to every community (Cole & Ellen, 2015).

Energy management is the process of tracking and monitoring energy to conserve usage in any facility. Generally, this approach can be defined as the means to control and reduce a building's energy consumption, thereby reducing costs, reducing carbon emissions, and reducing risk (Seyedabadi *et al*., 2022). The purpose of energy management is to ensure that the availability of energy is measured by authorized personnel to monitor and conserve its usage. The purpose of energy management is to constantly monitor the extraction, distribution, and conservation of all natural resources taken from the environment, weather, and geology. Examples of energy management include monitoring, evaluating, assessing, and controlling energy resources (Cole & Ellen, 2015).

Each country, state, or territory has its own energy managing bureau. This is for an agency that has the purpose of maintaining the natural resources of the environment. The world community is concerned that existing natural resources have been significantly depleted over time (Seyedabadi *et al*., 2022). The roles and responsibilities of the energy management bureau or the department control all legal and illegal activities concerning the use of energy resources. Politicians support the regulating energy bureau to ensure that there is a balanced energy resource. Third-party groups that are known to support environmental awareness contribute to the control of energy resources to prevent waste in the community (Pullinger, 2014).

The CF is a significant measurement of an energy management system. The footprint initially concentrates on carbon particles that are suspended in the Earth's atmosphere to determine if they are already threatening (Seyedabadi *et al*., 2022). There are several ways to ensure that energy resources are measured using different environmental and analyzing tools to determine the presence of carbons in the atmosphere. The presence of carbon molecules is analyzed through the use of molecular sampling to identify the content of this elemental substance dispensed in our atmosphere (Nässén & Larsson, 2015).

Carbon footprint analysis is a valuable tool for managing energy consumption and carbon emissions. It helps identify and recognize energy consumption and carbon emissions from various human activities (Ping *et al*., 2020). These analyses can be divided into two main types: process analysis-based life cycle assessment (LCA) and input-output table-based input-output analysis (IOA) (Gunathilake *et al*., 2021). A carbon footprint assessment is effective at understanding and managing carbon emissions from fossil fuel energy consumption (Pei *et al*., 2021). It has been applied to various sectors, such as construction activities, agriculture, and energy management systems (Leach *et al*., 2017; Vinci & Rapa, 2019; Guo *et al*., 2023). Additionally, this technique has been used to investigate the carbon sequestration potential of green roofs and the feasibility of using lime-dried sludge for cement production (Seyedabadi *et al*., 2022).

Furthermore, carbon footprint analysis has been integrated into energy management systems, such as smart grid management and microgrid energy management, to optimize energy consumption and reduce carbon emissions (Putri & Maizana, 2020; Yang Li *et al*., 2014). It also plays a significant role in supply chain management, where a hierarchical simulation-based approach has been proposed for estimating the carbon footprint of products flowing through a supply chain (Jain *et al*., 2012). Energy management technology has evolved to assist consumers in becoming more energy-conscious and reducing their consumption (Santarossa *et al*., 2016). Overall, carbon footprint analysis serves as a valuable tool for understanding and managing energy consumption and carbon emissions across various sectors.

Hävecker *et al*., (2012) indicated that there are gaps identified with the application of carbon footprints. This is due to the absence or lack of a metabolized form of carbon emitted in the world's atmosphere by numerous gas-emitting industrial facilities. These are factories, cars, and homes that release heat energy into the air, which constantly changes the factorial elements of the research applied in other countries(Seyedabadi *et al*., 2022). The continuous flow of carbon particles mixes with other gaseous substances, changing the composition of the element to become a new form of molecule. As more industries are installed each year, the density of carbon molecules continues to increase, affecting the air quality of the Earth's atmosphere (Shao & Shen, 2017).

The International Council on Clean Transportation (2014) indicated that the European Union is facing difficulty in implementing new standards for carbon emission standards in its member nations, but other member nations are still in their development stage. However, there are still problems that exist when dealing with an increasing amount of carbon. There should be CO_2 standards for passenger cars as well as light-commercial vehicles to prevent any degradation of air quality. This is a mandatory international law affecting the European Nations member states to pioneer the continent as a pollution-free country (Buhl & Acosta, 2016).

A carbon footprint still suffers from numerous gaps in terms of awareness. The main reason for this is the absence of laws that should have been responsible for implementing regulations (Gross, 2013). The lack of laws has allowed companies and several industries around the world to continue to release harmful carbon into the atmosphere (Seyedabadi *et al*., 2022). This procedure makes the carbon footprint one of the most important issues that people should consider when improving its legal responsibilities. This is why some companies continue to fail to comply with the rules and regulations. Government institutions will only take action when there are reported cases of harm attributed to pollution that has been occurring within their community (Seriño, 2017).

In terms of gaps, (Kuijer & Watson, 2017) states that economic disparity is one of the key problems that is causing concern for maintaining a sustainable environment in the world community. Not all countries enjoy a developed status that is similar to that of developed countries. Developing countries must focus more on balancing their political and socioeconomic needs because these are countries that are on the right track to ensure a well-balanced community in the future. This means that the priority of government units is to focus on the needs that are critical to the community rather than prioritizing carbon footprint analysis (Jones & Kammen, 2014).

Communication is an important factor that determines essential information regarding carbon footprint analysis. There is a gap in communication due to differences in the language used by different countries around the world. The role of patriotism is to cause an individual to become more associated with a footprint to become affiliated with technological analysis(Seyedabadi *et al*., 2022). The nationalism of a certain country inhibits its participation in communicating and coordinating with the issue of promulgating carbon footprints. A lack of communication inhibits the ability of a person to become more affiliated with the issue of causing misunderstandings between two or more individuals (Pearce, 2014).

The environmental gap, which is caused by the presence of natural disasters, is another concern. Some countries are located in areas where they have been experiencing severe weather (Shao & Shen, 2017). As a result, Mother Earth sometimes disrupts technology and facilities that should have helped assess and analyze the presence of carbon particles. Examples include earthquakes, tsunamis, tornadoes, volcanic eruptions, flooding, and severe blizzards, which can cause monitoring of carbon footprints to halt. This means that weather phenomena are considered to constitute a significant gap in this particular issue (McSherry, 2016).

2. MATERIAL AND METHODS

As more industrial facilities continuously emit smoke, the carbon footprint increases significantly. Some of the major facilities include factories that are responsible for producing thick fumes composed of carbon (Huber, 2015). Fossil fuels such as petroleum, oil, kerosene, and other flammable chemical components are responsible for increasing the number of facilities in the atmosphere. Land, sea, and air vehicles also produce carbon emissions that compensate for the footprints responsible for suffocating the environment. As demand for human consumption continues to increase, the level of carbon emissions slowly increases, generating more molecules that are dispersed in our atmosphere that could limit green consumerism (Akenji, 2014)

The term "footprint" is a recent concept that can be confusing for nonexperts due to differences in interpretations. Life cycle thinking (LCT) is an environmental assessment method that considers the entire supply chain of a product, service, or organization, from raw material acquisition to end-of-life processes. All of these methodologies are LCA-based approaches, ensuring a clear understanding of the environmental impact of a product, service, or organization.

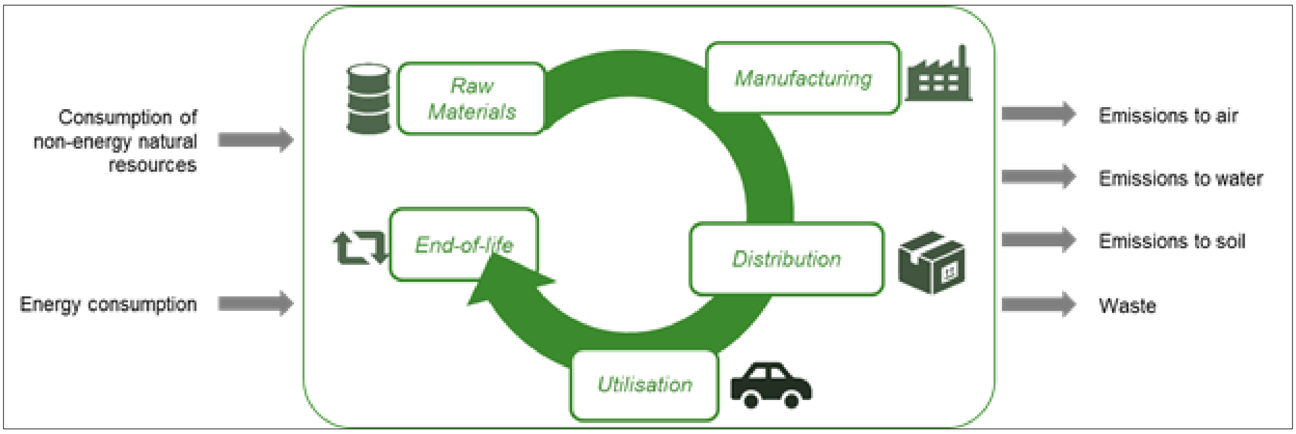
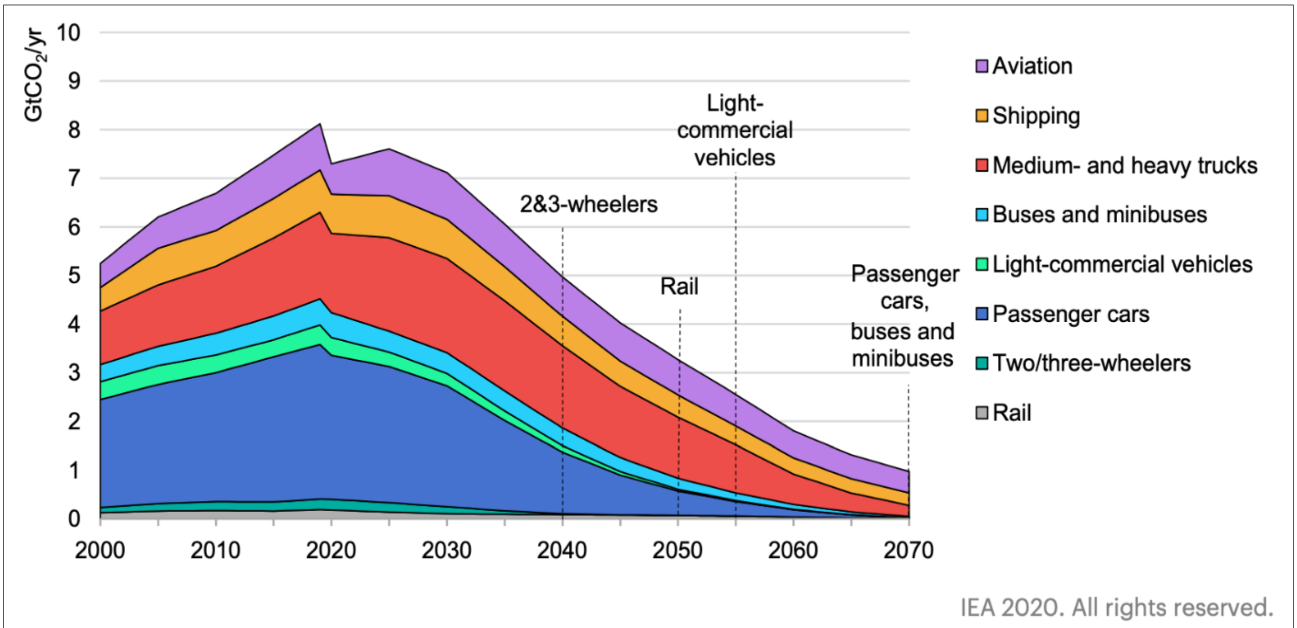


Figure 1: The carbon footprint cycle
Source: UNEP/SETAC Life Cycle Initiative

Figure 1 shows that an environmental footprint is a multi-indicator measure of impacts on products, services, and organizations. It can be applied to products and services (product environmental footprint – PEF), organizations (organization environmental footprint – OEF), and even regions or countries. The carbon footprint indicates the presence of harmful carbon materials that are produced in excess by different industries. Carbon is often produced as an end product of industrial machinery. The main consequence of producing carbon emissions could be the production of more harmful carbon aerosols that are slowly suffocating to the environment. This is due to the combination of numerous industrial facilities that are responsible for releasing numerous chemicals through aerosols to ensure that a suitable footprint can change the composition of the atmosphere (Bi & Hansen, 2018).

Transport emissions grew at an annual average rate of 1.7% from 1990 to 2022, faster than that of any other end-use sector except for industry (which also grew at approximately 1.7%). To get on track of the net zero emissions (NZE) by 2050 scenario, CO2 emissions from the transport sector must fall by more than 3% per year by 2030 (IEA, 2020).



Notes: Dotted lines indicate the year in which various transport modes have largely stopped consuming fossil fuels and hence no longer contribute to direct emissions of CO_2 from fossil fuel combustion. Residual emissions in transport are compensated by negative emissions technologies, such as BECCS and DAC, in the power and other energy transformation sectors.

Figure 2: Global Co2 Emissions from Transport in the lea's Sustainable Development Scenario 2000-2070
Source: IEA (2020), Energy Technology Perspectives 2020, IEA, Paris.

Figure 2 shows that the transportation industry has the highest demand for fossil fuels to generate energy in the community. The bar graph indicates that the motor coach has the lowest carbon dioxide emissions, with at least 40 CO2/gram passengers per mile. In contrast, the demand response, such as the increasing number of passengers traveling from one place to another, has 1,800 CO2/gram. There is growing concern that the use of fossil fuels is responsible for increasing the number of industrial facilities and vehicles that produce carbon molecules into the atmosphere, which usually occurs in developing countries such as Indonesia (Irfany & Klasen, 2016).

The railway facilities are the lowest bracket that produces carbon emissions in the transportation sector. This is due to the multichannel energy resources made up of energy resources. Railway cartridges and lines rely on electrical energy, which results in lower carbon emissions. Land vehicles are considered to produce more carbon emissions than railway cartridges. The main reason is the demand for gasoline and oil. Land vehicles rely on petroleum products to generate energy. This is similar to sea vessels, which also consume petroleum products that are needed to transport numerous types of products to improve the delivery of numerous services from one community to another (Isenhour & Feng, 2016).

Global carbon dioxide emissions from fossil fuels and industry reach 37.15 billion metric tons in 2022, with projections of a 1.1% increase to reach a record high of 37.55 Gt CO_2 in 2023 (EPA, 2023). In 2021, U.S. greenhouse gas emissions reached 6,340 million metric tons, a 2.3% decrease since 1990. This decrease was primarily due to the impact of the COVID-19 pandemic on travel and economic activity. However, emissions increased by 5.2% from 2020 to 2021, primarily due to increased carbon dioxide emissions from fossil fuel combustion, largely due to economic activity rebounding after the pandemic's peak, as shown in Figure 3.

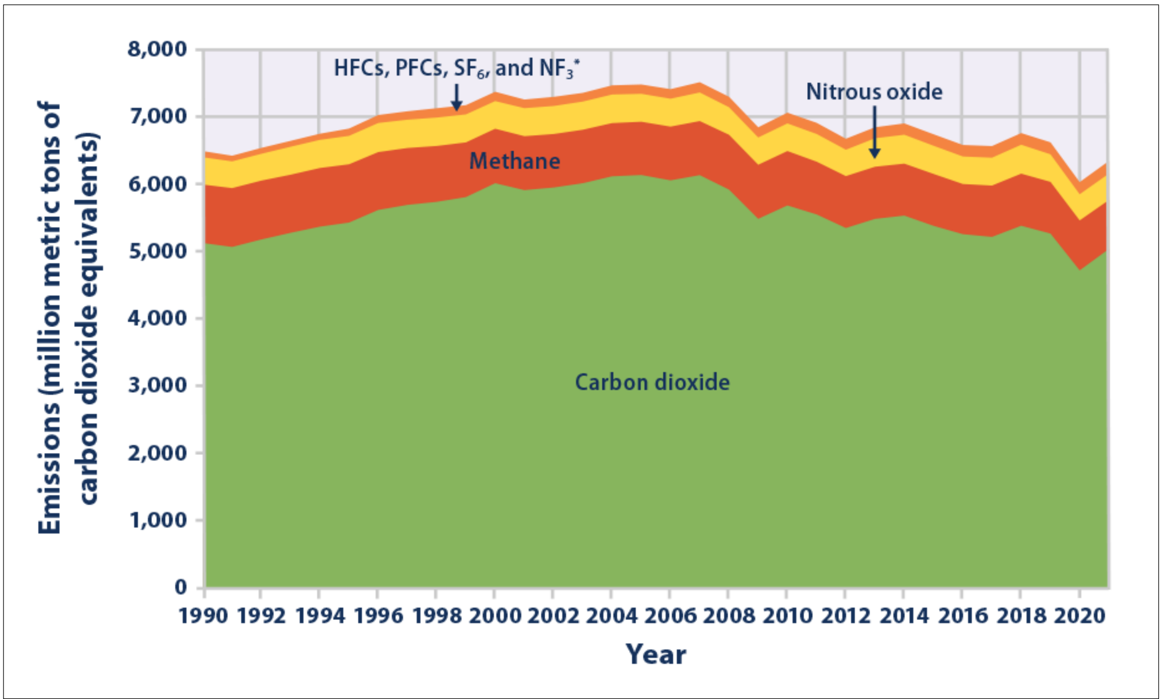


Figure 3: US Greenhouse Gas Emissions by Gas, 1990–2021
Source: Data source: U.S. EPA, 2023

Transportation is the largest contributor to U.S. emissions, accounting for 28.5% of 2021 emissions. Electric power, which has been the largest sector since 2017, accounts for approximately 25% of emissions. In 2021, 12% of U.S. greenhouse gas emissions were offset by net sinks resulting from land use and forestry practices. Major sinks include the growth of forests, including urban trees, and land management practices such as dumping yard trimmings and food scraps in landfills. Other sources of carbon dioxide emissions include wildfires, the conversion of land to cropland, and flooded land.

Emissions increased at the same rate as did the population from 1990 to 2007, causing emissions per capita to remain fairly stable. From 2007 to 2009, total emissions and emissions per capita declined due to a decrease in U.S. economic production. From 2010 to 2012, emissions decreased again due to the growing use of natural gas and renewables for electricity generation. From 1990 to 2021, greenhouse gas emissions per dollar of goods and services produced by the U.S. economy declined by 53%, possibly due to increased energy efficiency and structural changes in the economy as shown in Figure 4.

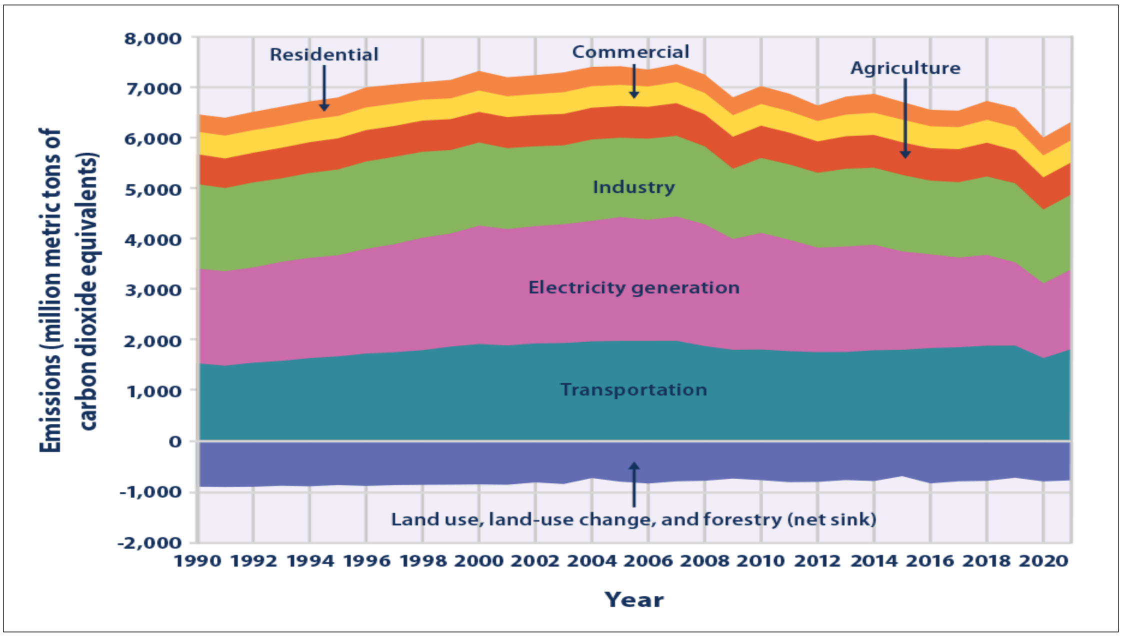


Figure 4: US. Greenhouse Gas Emissions and Sinks by Economic Sector, 1990–2021
Source: Data source: U.S. EPA, 2023

Factors such as economic activity, population, consumption patterns, energy prices, land use, and technology influence greenhouse gas emissions. Tracking these emissions involves direct measurements, fuel consumption calculations, and estimating associated activities and emissions.

Figure 5 illustrates the trends in greenhouse gas emissions from 1990 to 2021 per capita and per dollar of real GDP based on the total U.S. population. The data are indexed to 1990 as the base year, with a real GDP value of 209 in 2021 representing a 109 percent increase since 1990. The data are based on a 100-point scale (EPA, 2023).

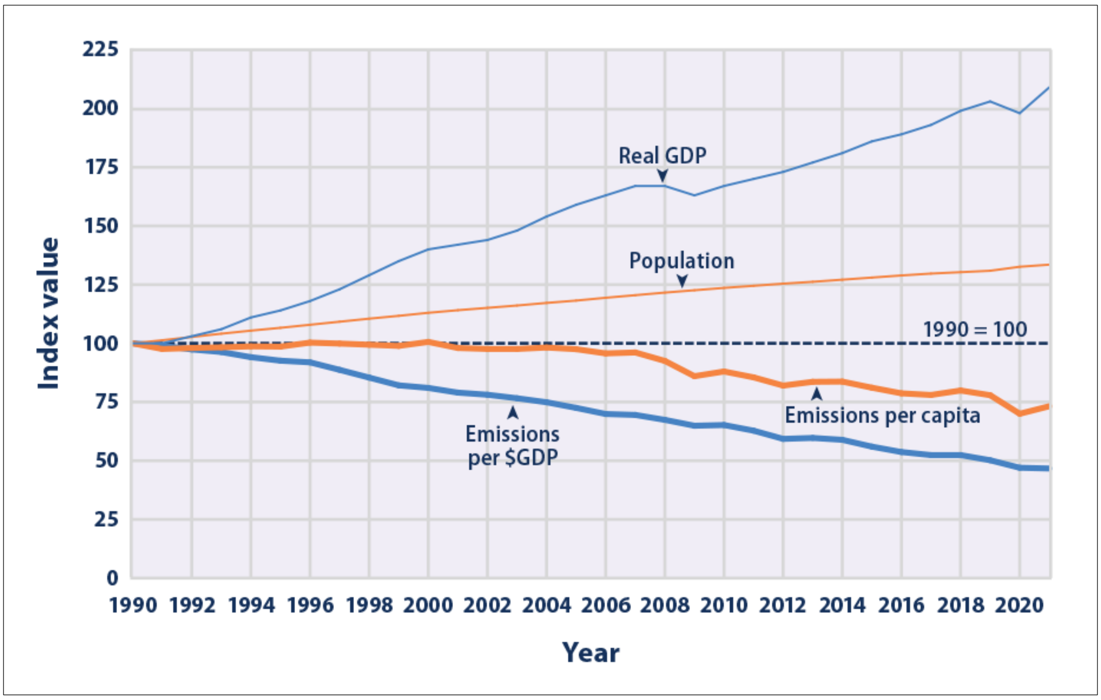


Figure 5: US Greenhouse Gas Emissions per Capita and per Dollar of GDP, 1990–2021
Source: Data source: U.S. EPA, 2023

Figure 4 shows that carbon emissions are based on a variety of finished products produced from industrial activities or operations worldwide. The highest demand for the raw material responsible for producing carbons is fossil fuels. At least four metric tons of carbon were produced from coal in 2015. This figure is expected to increase as more sources of fossil fuels are discovered in other parts of the world. Cement production is the second least common carbon production method, with less than one billion carbons produced in a year. The source of carbon comes from excavated soils that are mined from areas with high concentrations of limestone deposits and other chemical mixtures (Frenken & Schor, 2017).

Natural gas had at least two billion metric tons of carbon emitted in 2015. This is followed by petroleum, which has more than three billion metric tons of carbon emissions. The least renewable resources responsible for releasing carbon are gas flaring sources. The main reason is that gas flaring applications are overshadowed by the presence of renewable energy resources. Coal, petroleum, and natural gas have the most in-demand products, which are now causing multiple sources for the market to tap resources.

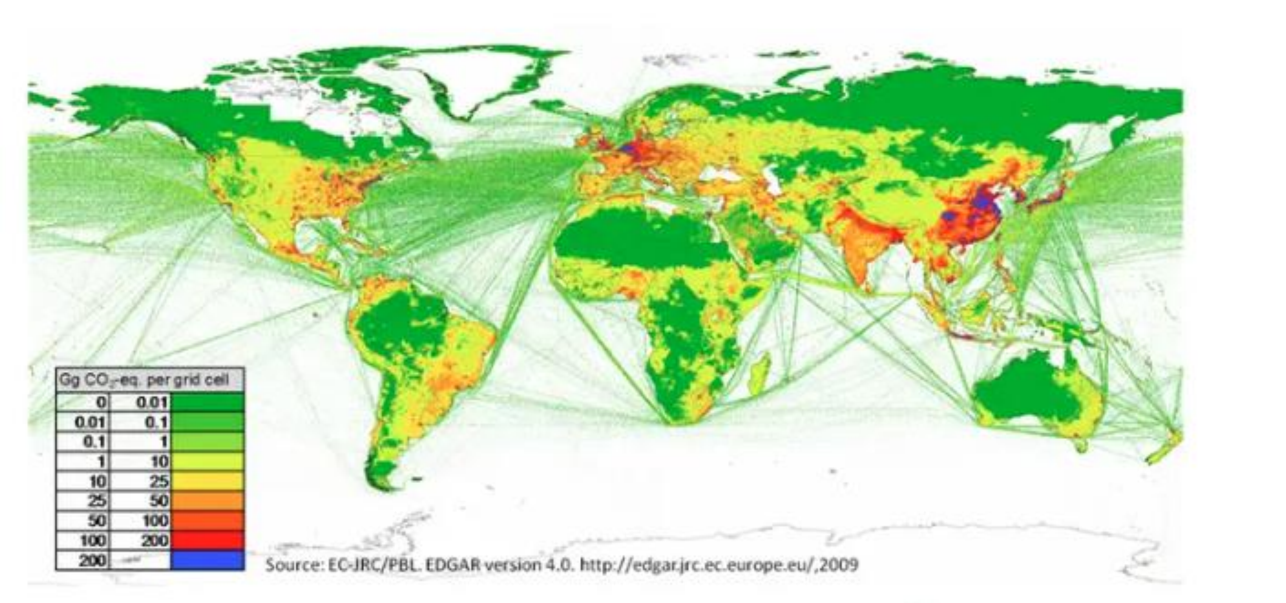


Figure 6: Distribution of carbon dioxide emissions
Source: Thomson Reuters Data stream

Figure 6 shows the distribution of carbons that are currently present in the world's atmosphere as of 2017, as presented in bright red and orange colors. The photo used an infrared satellite map that is able to detect carbon molecules in the world's atmosphere. The concentration of carbons is now more concentrated in the Northern Hemisphere than in the Southern Hemisphere (Mohr *et al.*, 2015). The high concentration of carbon in the Northern Hemisphere is due to the landmass that holds billions of communities that lie within the Northern Hemisphere. The Southern Hemisphere has a lower concentration of carbon particles, as shown in the photo.

The equatorial area of the globe has a significantly low level of carbon. The only areas where there is a high concentration of carbon are in some parts of South America and in Central African regions. The main reason is that a warmer environment disperses carbon molecules. The equator receives direct sunlight from the sun, which is why carbons are not found intact in these parts of the globe. Colder areas such as the polar regions of the world have a significant amount of carbon particles because they are compact and can affect the ozone layer of the planet (Huang & McElroy, 2012).

In Figure 7, the graph shows the global temperature index from 1880 to the present. As an observation, the global oceanic temperature during the 1880s was significantly lower than that in the present. The main reason is attributed to the increase in carbon emissions, which are responsible for causing the atmosphere to trap heat from the planet. When there is a significant increase in the amount of carbon particles in the atmosphere, the sea surface temperature gradually increases. There was a significant spike in the 1940s decade until 1945. This is attributed to the influx of nuclear weapons that were simultaneously detonated during the Second World War.

The sea surface temperature also has profound effects on the global climate, as it increases atmospheric water vapor over the ocean, which feeds weather systems that produce precipitation, increasing the risk of heavy rain and snow (IPCC, 2013; NOAA, 2021). Changes in sea surface temperature can also shift storm tracks, potentially contributing to droughts in some areas. Additionally, increases in sea surface temperature are expected to lengthen the growth season for certain bacteria that can contaminate seafood and cause foodborne illnesses, increasing the risk of health effects (IPCC, 2013; NOAA, 2021).

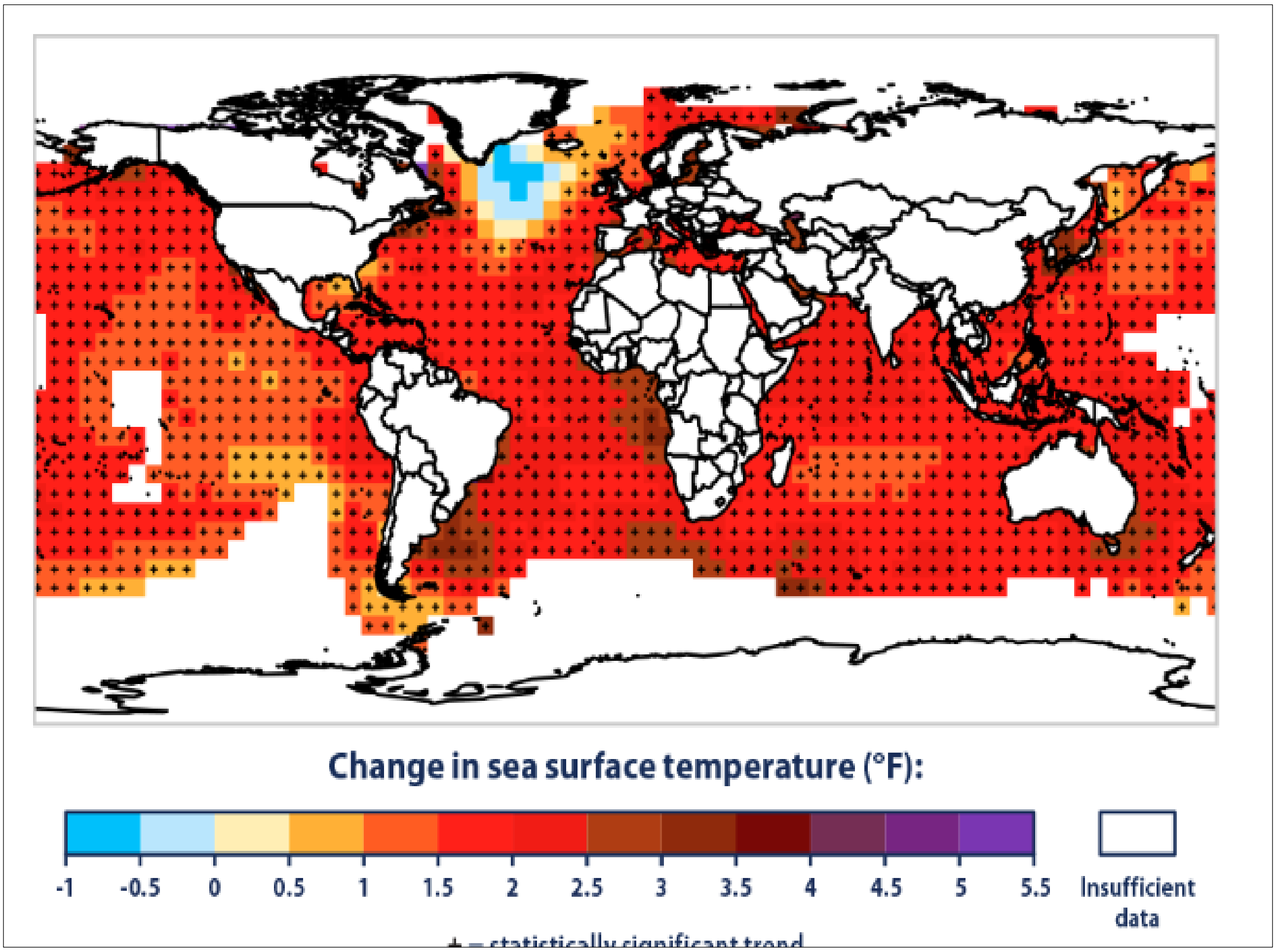


Figure 7: Changes in Sea Surface Temperature, 1901–2020
Source: Data source: IPCC, 2013; NOAA, 2021.

The heat index slightly decreased immediately after the Second World War and then slowly increased over the next few decades. The global oceanic temperature started to increase in 1970. The oceanic surface temperature started to experience rapid growth during the 1980s. This is attributed to the growth of new industries responsible for releasing fumes that are toxic to the environment. At the start of the 21st century, the global temperature once again increased at a rapid rate (IPCC, 2013; NOAA, 2021). The increasing rate indicates an alarming increase since it is now causing significant concern in the environment.

The sea surface temperature, the temperature of water at the ocean's surface, is a crucial physical attribute of the world's oceans. It varies mainly with latitude, with the warmest waters occurring near the equator and the coldest occurring in the Arctic and Antarctic regions. As oceans absorb more heat, the sea surface temperature increases, causing changes in ocean circulation patterns. These changes can alter marine ecosystems by affecting plant, animal, and microbial species; altering migration and breeding patterns; and threatening sensitive ocean life, such as corals (IPCC, 2013; NOAA, 2021). Additionally, increases in sea surface temperature could reduce the circulation patterns that bring nutrients from the deep sea to surface waters, leading to declines in fish populations and affecting people who depend on fishing for food or jobs.

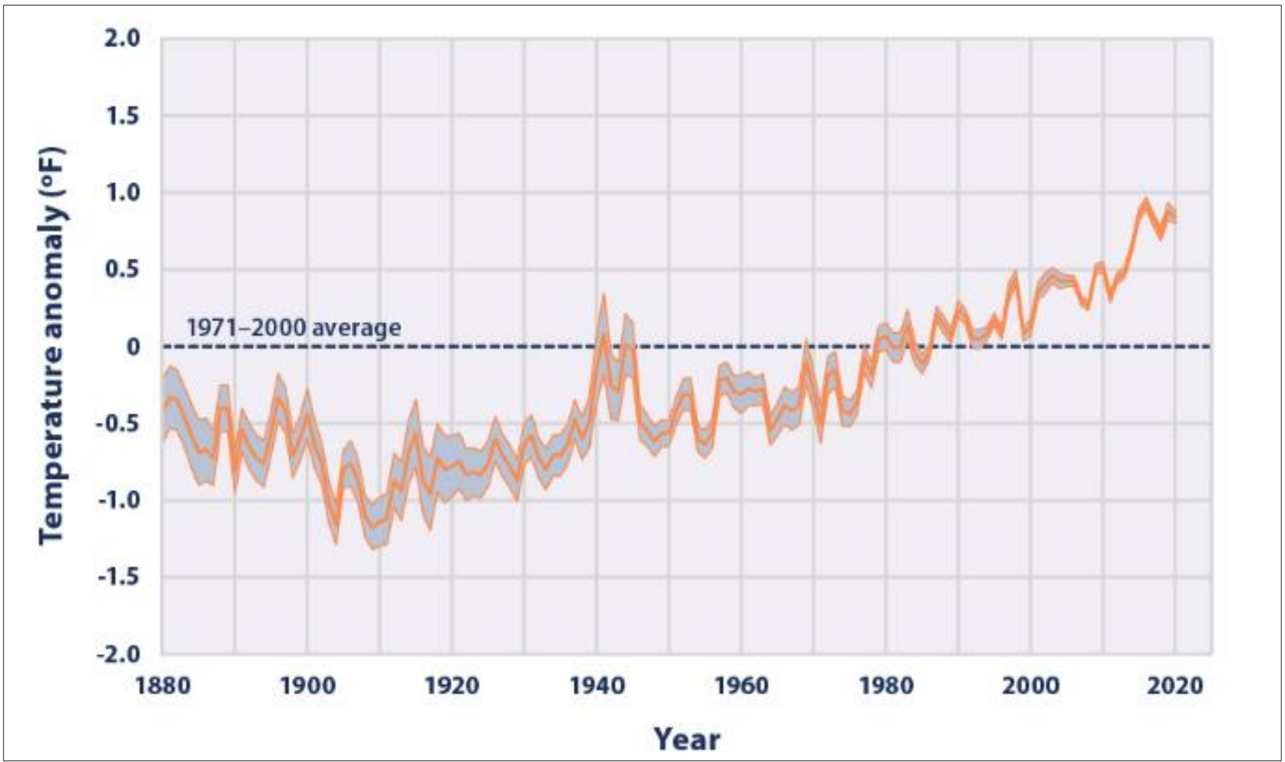


Figure 8: Average Global Sea Surface Temperature, 1880–2020
Source: Data source: IPCC, 2013; NOAA, 2021.

Figure 8 shows that the findings depict the global average surface temperature change since 1880, using the 1971 to 2000 average as a baseline. The shaded band indicates the range of uncertainty in the data based on the number of measurements and the precision of the methods used.

2.1 Methods

The purpose of using electronic devices in this paper is to process, manipulate, and produce new data. Examples of computer devices are laptops, the iPad, and smartphones. These electronic devices can collect and analyze information to ensure that the accuracy of the data becomes reliable for the researchers. Each electronic device was portably used to ensure that the participants could always process the collected data during the survey. These electronic devices that can connect to the internet can initiate connectivity between researchers and the internet.

Smartphones are mostly used for documentation. This device is built with a variety of multimedia hardware and software tools. The most important tool is the camera. The purpose of the camera is to capture moving and still images. The captured images are stored in both internal and external storage devices. If the files are large, the phone can still fill more space with other external files that are used to store all kinds of information. The stored information can be transferred from one electronic device to another.

The software applications used are office tools used in electronic devices. Examples include Microsoft Word, PowerPoint, Excel, and Access. Social media tools are also important for allowing each researcher and participant to engage in interactive communication. Hard copies of office supplies such as paper, ball pens, erasers, pencils, and other important office tools aim to record and present collected data during the research process.

This research used a qualitative research design with the use of the Thomson Reuters data stream. This study seeks to expound upon the subject matter of the study using observation of the phenomena to explain the main subject matter. All the observed phenomena will be supported by the evidence obtained throughout the study. The evidence is supported by facts and examples, while the main subject matter is discussed by the researchers, who defend their existence within the study.

3. RESULTS AND DISCUSSION

3.1. Discussion Factors

There are factors affecting the carbon footprint analysis in the air, as observed through energy management. Political factors are among the most common issues where delinquent local government units permit industries to operate, provided that they can bring kickbacks to their companies (Büchs & Schnepf, 2013). Corrupt officials are usually the culprits responsible for generating illegal industrial activities that produce carbon. There are government personnel who unknowingly install new industrial facilities in an area to generate profit without the knowledge of other government officials. This is why there are illegal industries that are operating that are now risking the environment and safety of the community.

Ottelin *et al*., (2018) economic factors dictate that coal is the cheapest way of generating energy sources that are mostly utilized by hundreds of countries around the world. However, energy management personnel are responsible for producing the highest quantities of carbon molecules in the atmosphere. There are societies that reject the use of alternative renewable resources. These include the installation of solar power plants and wind turbines, which are exceptionally more expensive than coal, which is 10 times more expensive. However, developed and developing countries still prefer the most economical way of producing energy without risking their financial investments to generate energy in their communities (Poom & Ahas, 2016).

Chabrol, (2016) indicated that energy management is now stimulating social factors through the application of information and dissemination campaigns to the affected community. There is a lack of information and dissemination campaigns responsible for letting the community disregard the warnings of the government regarding the potential hazards of carbon footprint consequences. The major reason is that they did not observe that energy management experienced the potential impacts of carbon footprint analysis that could make them realize its regressing impacts on the community. A lack of understanding and appreciation makes it impossible to help reduce the potential impacts of carbon footprints affecting some parts of the community (Kibert, 2016).

Environmental factors are the most concerning issue for carbon footprint analysis. The issue of air pollution has been blamed for the excessive production of carbon emissions. In energy management, concerns over the issue of global warming are now responsible for increasing levels of oceanic waters (Lorek & Spangenberg, 2014). Global warming is another concern because it causes frequent severe storms that can form in any part of the world. Tropical disturbances become more intense due to warmer air, which increases the humidity suitable for cloud formation. An increasing sea level is also one of the outcomes that has been caused by the increasing carbon emissions occurring in our society (O'Rourke & Lollo, 2015).

Human factors are blamed upon energy management personnel due to the increasing demand for energy to survive. The main reason is the increasing number of people who are now causing another cancer-related society. A greater population means that more energy is needed to provide energy resources for the whole society (O'Rourke & Lollo, 2015). The need for more industry, transportation, energy supply, and energy-consuming facilities is needed to cater to the basic needs of the population. This is why more carbon particles are released into the air on a regular basis, saturating the whole atmosphere and affecting the general population (Dlugokencky & Tans, 2015).

Energy management is also considering the issue of mechanical factors. However, obsolete machines are still inclined to use fossil fuel and petroleum. This phenomenon is usually observed in developing countries, as more companies prefer machinery that relies on petroleum products (Jalas & Juntunen, 2015). Small and medium enterprises prefer using old machinery to produce new commodities rather than new products, which are much more expensive. There are obsolete products that are disposed of considerably by companies. However, small andmedium-sized companies still consider old machines that are functional and reliable for producing new products and services (Hille, 2016).

3.2 Energy Management Solutions

Energy management personnel are considering an alternative source of renewable energy resources. These facilities produce cleaner air than nonrenewable resources, which is now a growing new facility (Wiedmann *et al*., 2016). Even if there are significant investments needed for the installation of renewable energy resources, companies will profit in the long term because the carbon footprint will no longer be detected by the regulating agencies. The increase in renewable energy resources results in a cleaner atmosphere. The introduction of a renewable energy resource limits carbon particle production because the energy it generates comes from a greener source (Craig & Baxter, 2016).

Regular monitoring of carbon footprints is important for energy regulating agencies that are concerned with detecting carbon particles. The impact of monitoring helps to identify areas that are holding high concentrations of carbon footprints that are now causing society to determine the degree of environmental concern to the community (Zhang *et al*., 2015). The energy management team will be able to detect the exact number of measurements whenever they are assessing the existence of carbon particles that affect a certain community. The main reason is to determine the areas that have the highest concentrations of heavy metals compared with the areas with lower carbon concentrations (Rudd, 2015).

A feasibility study is the process of determining the factors that are associated with the existence of a carbon footprint. The energy management team will be responsible for conducting a regular assessment of the problems associated with the impacts of the carbon footprint on the community (Shove & Walker, 2014). This is the process through which one seeks to analyze the factors associated with the existence of carbon emissions. In addition, energy management will detect problematic facilities that are known to produce unacceptable carbon structures that are causing environmental concerns. The detected companies or facilities will then be subjected to legal apprehension by the local government unit (Hoover, 2014)

Maintenance or repair is one of the traditional functions of energy management units for ensuring that facilities no longer produce carbon emissions. Mechanical engineers and laborers will be tasked with fixing parts that are no longer functioning efficiently. Energy companies want to ensure that the damaging impacts of carbon emission-producing facilities will decrease carbon emissions. Changing some parts of machinery is a significant solution for eliminating defective parts that cause environmental concerns. Maintenance further decreases the level of emissions, which can lessen the saturation of carbon in the atmosphere (Karl, 2015).

4. CONCLUSION AND RECOMMENDATIONS

Carbon footprint analysis is crucial for determining the impacts of carbon particles in the atmosphere. Energy management operations aim to improve this by measuring carbon in the atmosphere. Transportation uses natural resources, including land, sea, and air vessels, to produce energy. The most popular forms of carbon production are petroleum, natural gas, coal, and gas-fired products. The study also highlights the global temperature change and the increasing number of carbons, with the majority being displayed in the northern hemisphere, particularly in polar areas, due to temperature-induced binding of carbon particles. The study recommended that the expected outcomes include extension services, more productive and resilient indigenous knowledge systems, youth and women's involvement in knowledge-based activities related to lower GHG emissions, optimal resource use, cross-cultural learning, and rangeland recovery.

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