Global Scientific JOURNALS
GSJ: Volume 10, Issue 3, March 2022, Online: ISSN 2320-9186
www.globalscientificjournal.com

SUSTAINABLE ARCHITECTURE AND THE CLIMATE CRISIS

Dr. Ferdinand F.O. DAMINABO
Rivers State University, Nkpolu, Oroworukwo, Port Harcourt. Rivers State, Nigeria.
E-mail; ferdydaminabo@yahoo.com

ABSTRACT

The unanimous verdict from the global scientific community and environmental scientists is that there appears to be a discernable human influence exacerbating the climate crises and that human activity is at the root of the problem. The use of predominantly fossils in the energy sector since the industrial revolution and to power the energy needs of our ultramodern 21st century civilization had thrown spanner into the wheels of a friendly and habitable environment with the ecosystem at a terrible risk. However, Sustainable Architecture presents within the built environment a mitigation route on how to design and construct buildings that use resources efficiently in a way that meets the requirements of ecological sustainability and biodiversity. Sustainability is the new normal in order to live responsibly in our human induced climate crises. This paper seeks to delve into how architecture can play a key role in our eco- reappraisal involving relationship of species and the environment, especially as it patterns to the built environment and to reduce the existing carbon footprint and pollutions that put the global climate at a colossal risk.

KEYWORDS: Sustainable Architecture, Climate Crisis and Global warming

1. INTRODUCTION

Sustainable architecture and the climate crises are like sesame twins in that one presents a panacea for mitigating climate change and global warming by adopting strategies that address the root causes of the later. It is commonly reported that just about half of global CO_2 emissions is attributed to construction and operations of buildings.

The emission of GHG tends to upset the delicate balance of the environment affecting humans, plants and animal species thus destabilizing the eco-balance. Sustainable solution require a thorough understanding and application of building physics and technology to ensure that the building envelope, materials and systems work together to create an energy efficient building that is operational and reusable.

In the past, buildings arose from the necessity of enclosure for safety or protection from the elements but that was before the global climate crisis and global warming all pre-industrial. This infusion and diffusion of technology must be focused on the need to orient buildings towards sustainable development goals and climate sensitivity so that construction activities must include the holistic assessment of the impact on the environment. This is because of its share geographical and carbon footprint, its energy use, water and pollution from deconstruction that normally end in landfills. The report on emissions for greenhouse gases in the United States[1], estimates that around half of all the non-renewable resources mankind consumes are used in housing construction, making it one of the least sustainable industries in the world. Mitigation must therefore be strongly considered in line with sustainable development goals and the fate of our global climate which is in sharp focus and the object of this study.

2. AIMS AND OBJECTIVES

Architecture in itself hovers over the arts, Social Sciences, Engineering and Technology and more recently ai and robotics including of course the knowledge of building physics which has come on stream to drive new frontiers in architecture. Sustainable architecture is a shift in real time that focuses on architecture with climate sensitivity as the main focus that addresses the emergence of a hostile environment due to global warming. This paper is about the role of Sustainable Architecture in the face of precarious climatic and environmental issues plaguing our ecosystem due to excessive addiction to fossil fuels and then seeking alternative routes out of the climate quagmire.

© GSJ

3. METHODOLOGY

In order to properly drive a wedge and respond to a climate in crisis and ensuring a sustainable built environment, the prevailing thesis will be creating a transition from an ecological perspective to an ecosystem where plants, animals, people and micro-organisms all form an integral part of robust interconnectivity where everything depends on everything. Nothing disappears and where everything must go somewhere. To deepen the perspective, extensive literature studies and a range of information gathering tool and sources is deployed to unravel various ramifications of the subject.

The relationship between architecture and the climate had been the common norm until modernism and the international style established its dominance where a building in Tokyo or Japan looks and feels exactly like one in New York city without any inference on the climate and geography. This is a huge conundrum the further exacerbates the global climate crises now requiring a response to curb the enraging menace posed to the environment and this paper will try to poke on how mitigation can be driven through Sustainable architectural practices that will require lifestyle changes.

4. CLIMATE CONUNDRUM

The global climate; ozone layer, greenhouse gases, temperature, solar position and sun path, historical weather patterns, ecology all play significant role in determining current disposition of our global climate and primarily nature also play a key role in achieving climate-sensitive architecture. This is in lockstep with site-specific environmental conditions such as wind, rainfall, humidity with seasonal variations.
Again, it is proper to acknowledge that one of the root causes at the center of the climate crises is CO_2 emissions and the greenhouse effect. Carbon compounds in the atmosphere is key to ensuring that the planet is warm enough to support the diverse life forms and biodiversity sustaining an ecological wonder world. Carbon remains the key element for life and human existence on earth with compounds of the element forming the basis for plants, animals and micro-organisms. Carbon cycle ensures that atmospheric carbon taken in by plants and animals is gradually released into the atmosphere after they die and or decompose.
The atmospheric carbon taken in by plants convert carbon dioxide CO_2 into stems, trunks and leaves by the process called photosynthesis and the carbon enters the food chain as plants are eaten by animals.

However, climate complications ensue when there is too much atmospheric carbon in the atmosphere with other greenhouse gases due to excessive use of fossils resulting in a greenhouse effect, thus raising the average global temperature and causing climate change.
Contemporary architecture mimics a linear model; uses energy from fossil fuels, water, various building materials and other raw materials and accessories essential for life and have been squandering energy inefficiently at a cost of the global climate.

Planning a sustainable environment, society will require a holistic approach to learn from and cooperate with nature responsibly and sustaining a healthy built environment. The global scientific community is unanimous in the fact that human activity is at the root of a turbulent and hostile climate. We inhabit an ecosystem with unfathomed complexity where plants, animals, micro-organisms, people all form an integral part where everything is interconnected with each other and almost cyclic, thus a sensible compromise is required in order not to reach a dangerous tipping point.

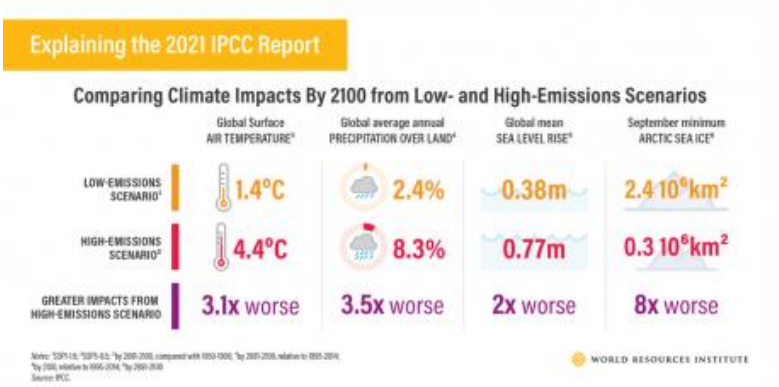

Figure 1: Climate impacts by 2100 Source [2021, IPCC Report]

However, findings from the IPCC standpoint paints a grim picture of the future with the climate getting to the edge of the cliff, such as sea level rise due to collapsing ice sheets or ocean circulation changes being of major concern. With greater warming being predicted of up to 3 degrees C (5.4 degrees F) and 5 degrees C (9 degrees F), respectively, projections suggest an eventual near-complete loss of the Greenland Ice Sheet raising sea levels by7.2 meters and complete loss of the West Antarctica Ice Sheet, a melting of this level will redefine coastlines everywhere. [IPCC Report, 2021]

The history of changes in global surface temperature relative to 1850-1900 as well as changes in global surface temperature; decadal average and annual average respectively relative to 1850-2020 paints a gloomy picture for the planet going forward and requires urgent action to mitigate the prevailing trend. This is in lockstep with the Paris accord and COP26, [2021] concluded Glasgow, UK recently.

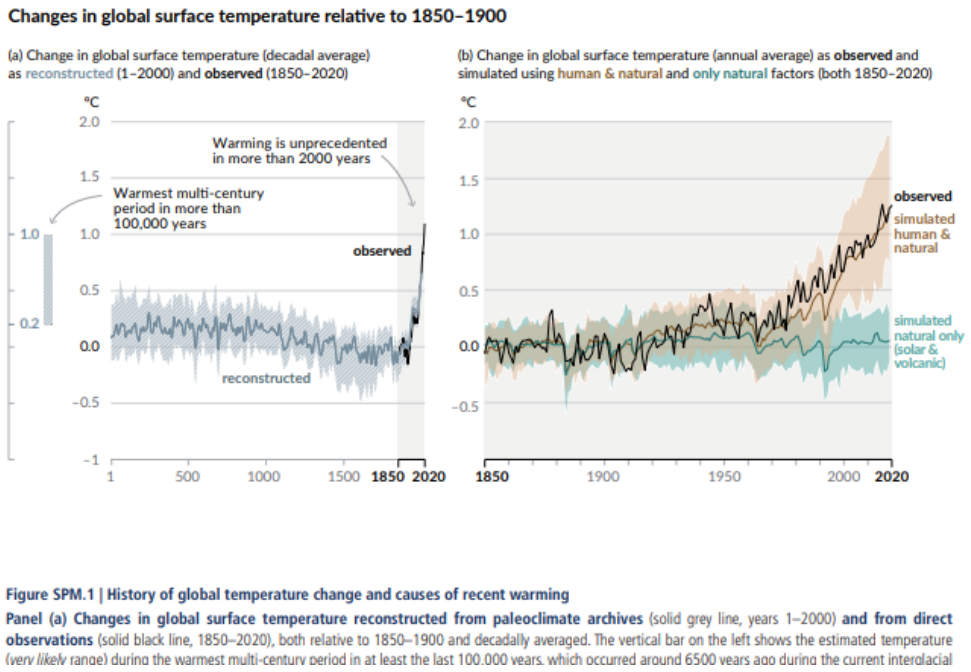

Figure 2: Changes in global surface temperature. [Source [2021, IPCC Report]

5. THE GREEN OPTIONS

The concept of Sustainable Architecture also known as “Green Architecture” or “Green Building” and or “Zero Carbon Building” among others is a theory, science and style of buildings designed and constructed in accordance with environmentally friendly principles. [2] Green design is an approach to building that minimizes harmful effects on human health and development. The green architect or designer attempts to safeguard air, water and earth by choosing eco-friendly building materials and construction practices. [3]

Bureu, 2015, defines Green Architecture as an understanding of environment friendly architecture under all classifications and contains some universal consent;

- Ventilation systems designed for efficient heating and cooling
- Energy efficient lighting and appliances
- Landscape planned to maximize passive solar energy
- Minimal harm to the habitat
- Alternative power sources as solar power and other renewable energy sources
- Responsible harvest of woods
- Adaptive reuse of older buildings and others.

Source: Adelberth, (1997)

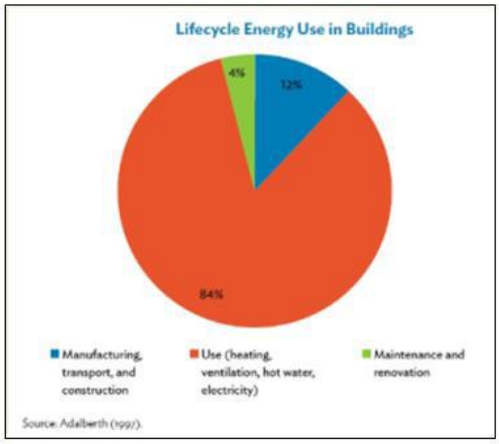

Figure 3: Societal and Lifestyle Choices as a low-carbon Strategy

Source: World Bank (2006)

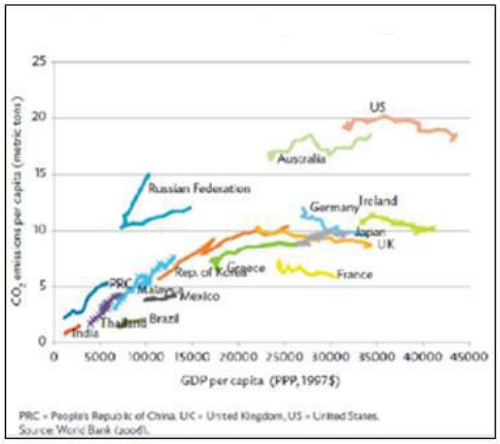

Figure 4: Energy Use, Emissions, and Economic Growth of Countries

Despite all the low energy strategies, a thoughtful moderation of lifestyle of individuals and nation states and their carbon footprint can energize the fight of global warming causing climate change. Lifecycle energy use in buildings can be monitored and measured as a low carbon development strategy Figure 3, as well as being seen from the perspectives of energy use, emissions and economic growth in terms of GDP per capita of countries in real-time. Figure 4. Sustainable development is a term utilized for a collection of terminologies involving improvements related to social, economic and the environmental conditions of individuals and a better quality of life. [5]

A cocktail of measures will be required to shift the needle on climate change and the anticipated consequences on the environment if stringency is not part of the norm as things get worse.

5.10 RENEWABLE ENERGY TECHNOLOGIES

From a slightly different perspective, building envelopes described as smart building envelopes has entered the Sustainable mix of current solutions. Building envelopes which are now designed to resist heat into and out of the conditioned space and to adjust resistance to heat flow in response to the prevailing weather conditions are actively being pursued. Active envelopes absorb solar radiation and store it until the energy is required and can then be provided using microencapsulated phase change materials. The integration of renewable energy technologies into the building envelope and environmental systems within buildings is still at the early stages

and gaining traction and global acceptance as the way forward in ameliorating the effects of global warming. Conventional integration of Photovoltaic cells [PVC] into roofs and walls of buildings [Figure7 - Figure11] is now being explored changing the calculus from the normal tradition, including more advanced strategies of combining a number of renewable energy technologies within a single system to enhance performance, thus protecting the building from external agents using building envelope as passive shelter. [Figure 5 and Figure 6]

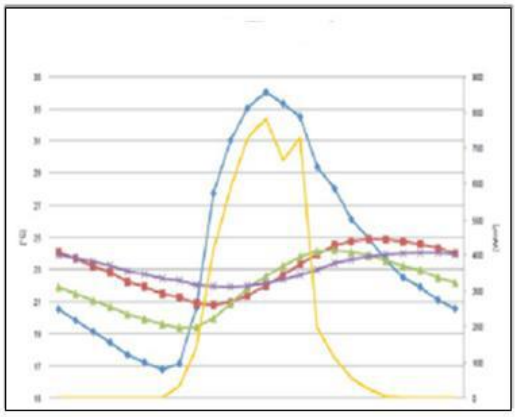

Figure 5: Tracking Surface Temperatures

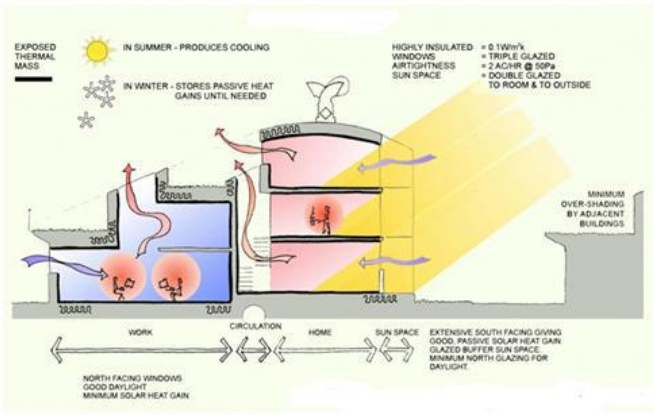

Figure 6: Building Physics

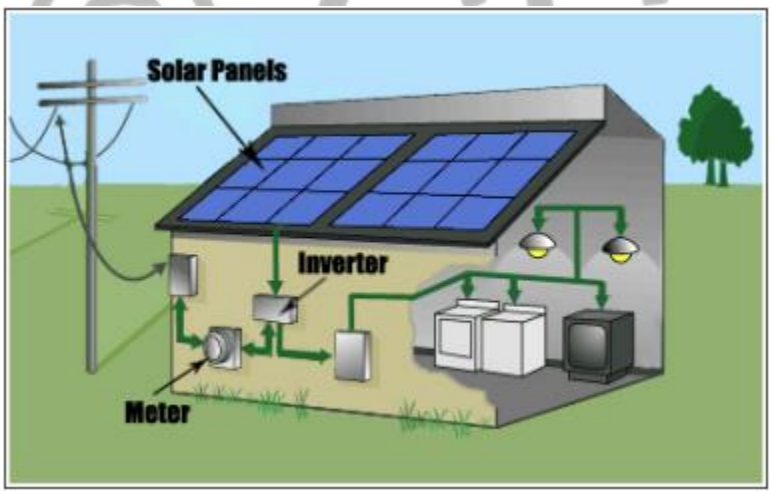

Figure 7: Solar PV Building Integrated System. Source: Navid Gohardani,[2014]

Figure8 Flat roof PV model and mini PV Farm
Source-*http://www.flickr.com*

Figure 9.Building Integrated Photovoltaic Panels [BIPV]
Intercultural Center, Georgetown University in Washington, DC
Source kisscathcart.com

Figure10 Building Integrated Photovoltaic Panels [BIPV]
Source;Energypedia.info.

Building compactly and minimizing the ecological footprint is common as are on-site handling of energy acquisition, on-site water capture, alternate sewage treatment and water reuse. [6] Passive systems are simple, have few moving parts and no mechanical systems, require minimal maintenance and can decrease or even eliminate heating and cooling cost. [7] The photovoltaic system meets these considerations with no moving parts whatsoever but generates electricity, when fully installed as can be seen in Figure10. Green building materials on the other hand can be selected by evaluating characteristics such as reused and recycled content, zero or low off gassing of harmful air emissions, zero or low toxicity, sustainably and rapidly renewable harvested materials, high recyclability, durability, longevity and local production.[8] Passive techniques and technologies drive architects response and design approach to energy conservation, efficiency and consumption limiting carbon dioxide emissions and thus creating zero-carbon buildings. However, this will not go far enough if life style changes are not part of the all-inclusive measures targeted to a friendlier ecological tuft.

Figure11: Types BIPV Installations
Source:www.Solarify

6. DISCUSSIONS

Global warming which is responsible for climate change is spurred by increases in GHG pumped into the atmosphere over the last century propelled by the industrial revolution. GHG including methane, nitrous oxide, chlorofluorocarbon [CFCS] and more seriously, fossil fuels and deforestation are major drivers of the trend globally. Sustainable architecture produces and guarantees environmental and socio-economic benefits. Environmentally, it helps reduce pollution, conserve natural resources and prevent environmental degradation and economically reducing the amount of money that building's operators have to spend on water and energy and improves productivity of those using the facility. [9] Moving towards a greener Architecture is a well-conceived path and main goal of the present architecture of our time. [10]

Sustainability is obviously the "new normal" in an attempt to progress and live responsibly knowing very well that the climate crises is human induced basically by our unrelenting corrosive activities and lifestyle. Buildings remain the biggest source of pollution responsible for a greater proportion of CO_2 emissions and therefore calling for retrofitting of existing infrastructure into greener healthier places. Eco-system reappraisal and that is, relationship of species and the environment needs urgent evaluation to reduce the scope of existing carbon footprint and pollution that do exist currently.

7. CONCLUSION

The climate crisis obviously has prompted a general rethink by the entire building sector and building construction establishment and stakeholders, architects and engineers alike that the prevailing thesis of modern architecture and the international style mode of building realization needs an urgent review. This model resulted in buildings round the globe looking more the same

and at variance with when buildings were adapted to the climate and responded to ecology and the environment.

Sustainable Architecture in striving to create a sustainable built environment is an effort to achieve true sustainability that guarantees and promotes transition to sustainable technologies and renewable energy sources that will limit further damage to the climate or speed up rise in global temperature. The consensus and global assessment is that of migrating from the continued use of fossils which is connected to the building industry in a global scale and it is clear that no move towards sustainable development can go ahead without radical changes in architecture, construction and spatial planning.

The focus at the moment must be on energy conservation, increased efficiency and creating zero-carbon buildings that ensures health and social wellbeing of people throughout the lifespan of building. Sustainable architectural practices will therefore be regarded as the right direction to follow in order to achieve desired objectives and thus mitigating the root cause of the climate crisis.

REFERENCES

1. United States department of Energy(USDOE),(2010)Energy Efficiency and Renewable Energy, Federal Energy Management Programme,1-34
2. Amany Ragheh et al.(2016) ,Green Architecture: A Concept of Sustainability, Procedia-Social and Behavioral Sciences, vol 216, Pg778-787
3. Roy Madhumita,(2008), Importance of Green Architecture today, Department of Architecture, Jadavpur University, Kolkaka, India
4. Burreu, G (2015); Sustainability Education by Sustainable School Design, Dokuz Eylul University, Department of Architecture, Turkey, Procedia-Social and Behavioral Sciences, vol 186, Pg868-873
5. O. Ortiz, F. Castells & G. Sonnemann,(2009) Sustainability in the Construction Industry:A review of recent developments based on LCA. Construction and Materials vol.1,pg 28-39.
6. Smith, Michael G.(2002); ‘’The case of Natural Building’’ in Kennedy. Smith and Wank
7. BCKL,(2009); Solar Hot Water Heating, Borough Council of King’s Lynn & West Norfolk, RES-2318-0609
8. Cullen, Howe J. (2010); Overview of Green Buildings, http://epa.gov/greenbuildings/pubs/
9. Thomas Rettenwonder; (2009) The Principles of Green Building Design, Niklas SpitzMontercy Peninsula College INTD62.
10. Mohammadjavad,M., Arash, Z., Ariya N.,Setareh G., Narjes E.(2014) Dilemma of Green and Pseudo Green Architecture based on LEED norms in case of developing Countries. Journel of Sustainable Built Environment vol3. Pg 235-246