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Energy & Environmental Physics

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Abstract: *Physics is essential for understanding natural phenomena. It provides a basis for understanding the impact of humans on the environment. This understanding is essential for environmental stewardship. Environmental physics is essentially the applications of the principles of physics to environmental processes and problems. Environmental physicists use the principles and techniques of physics to study the earth's environment. They have made significant contributions to understanding global climate change and other environmental issues. This paper provides an introduction to environmental physics.*

Keywords: Environmental physics; environmental physicists; environmental science; natural science

I. INTRODUCTION

In a modern society, it is easy to forget that our society depends largely on the environmental processes that govern our world. The basis of our economy depends on the soils that sustain our agriculture, the rivers that provide our water, the minerals that provide the raw materials for the goods we consume, and the plants and animals that serve as our food [1]. Human inventiveness has introduced chemicals and materials into the environment. Environmental problems arise from interaction between man and nature. We live in an age where the greatest threat to our future is not war, but climate change. Scientists and engineers across the world are working together to solve this looming environmental catastrophe [2]. Physics has always been concerned with understanding the natural environment. The word "environment" commands a very broad meaning and it includes air, land and water, plant and animal life including human life. It may be regarded as the medium in which any entity finds itself. Every environmental issue can be represented, explained, and resolved using energy and matter fundamentals. Matter refers to anything that has both mass and volume, and it appears in three basic phases: solids, liquids, and gases. Energy lies at the heart of environmental issues. Understanding the forces and laws that underpin the interactions of matter and energy form a major part of environmental physics [3]

II. ENERGY RESOURCES

1. Energy Source: An energy source is any material or type of matter from which energy can be obtained. Examples include the sun, waves, tides, uranium, wind etc.
2. Energy Resource: This is an energy source that is available in economically or commercially viable quantities. Examples include HEP plants and the sun are some of the energy resources in Cameroon.
3. Primary Energy Sources: These are energy sources that can be used in the form in which they occur naturally. For example wood, natural gas, sun, crude oil etc.
4. Secondary Energy Sources: These are energy sources derived from processing the primary energy sources. For example biogas, electricity obtained from a hydropower scheme.
5. Functional Energy: This is energy available to the end user. For example electricity, chemical energy from petrol, kerosene, gas etc. it could be derived from both the primary and secondary sources.
6. Renewable Energy Sources: These are energy sources which do not get finish. This is because the rate at which they are generated is greater than the rate at which they are used. Examples include the sun, waves, tides, wind, flowing streams. They are also referred to as infinite or regenerative energy sources.

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7. Non – Renewable Energy Sources: These are energy sources which gets finish over time. This is because the rate at which they are generated is less than the rate at which they are being used. Examples include fossil fuels like coal, oil and natural gas, uranium.
8. Fossil Fuel: They are a group of primary fuel namely coal, oil and natural gas. They are formed from the remains of plants and animals that lived millions of years ago. They originate from radiant energy which have been transformed into chemical energy and stored over a long period of time.
Coal: It comes from the remains of plant life. The main use of coal is to heat water to produce steam which turns turbines to generate electricity. Coal can be gasified or liquefied and use for transportation
Oil and Natural Gas: They are formed from the bodies of marine animals and plant remain by excess pressure and heat in the sea bed. Oil is important because most of the fuel used by road vehicles, ship and aircraft are extracted from oil. In addition, oil is the basic raw material from which fertilizers and most plastics are formed. Gas which occurs mainly as natural gas, methane is used for cooking.
9. Biofuels: They are fuels derived from sunlight energy converted to chemical energy and stored over a short period of time. Examples include firewood, saw dust, kennel shell and leaves. They are used for cooking, drying, smoking etc

III. CONCEPT OF ENVIRONMENTAL PHYSICS

Physics is the study of the forces and laws of nature. It is the branch of physics concerned with the measurement and analysis of interactions between organisms and their environment. It is often regarded as the fundamental science, because all other natural sciences (such as astrophysics, geophysics, chemical physics, and biophysics) apply the principles and laws of physics. Physics relies heavily on mathematics as the tool for problem formulation and quantification of principles. Physical principles are largely derived from direct observation and experimentation of nature. Physics is a broad field including mechanics, optics, electricity, magnetism, electromagnetics, thermodynamics, and quantum mechanics. Environment may be regarded as the medium in which any entity finds itself. Environmental physics is essentially is a physical science. It applies the theoretical and experimental techniques of optical, surface, and condensed matter physics to the environmental problems facing us today. It embraces the following concepts: human environment and survival physics, built environment, urban environment, renewable energy, remote sensing, weather, climate change, environmental health, and environmental control. It deals with atmospheric science, pollution detection and remediation, dynamical processes at land-water, colloidal science, and biological effects of pollution, and bioremediation science, weather forecasting, and environmental control. To fully understand the complexities of the environment and to address environmental problems effectively, the underlying physics must be combinedwith biology, chemistry, and geology. Effective management of human interaction with an environmental system requires simultaneous progress on several fronts.
Introduction: It is a branch of physics concerned with measurement and analysis of the interaction between living things and their environment. Some aspects of environmental physics include

- Ionizing radiation and radioprotection
- Climate change
- Depletion of the ozone layer
- Natural hazards
- Weather forecasting

A. Ionizing radiation and radioprotection

Definition: Radiations are electromagnetic waves or fast moving subatomic particles. Ionizing radiations are those radiations that possess enough energy to liberate electrons from atoms or molecules upon interaction, thereby ionizing them. E.g α – , β – particles, ɣ – rays and X – rays. Non – ionizing radiations on the other hand possess less energy and so do not cause ionization. E.g low frequency UV, visible light, IR, microwaves, low frequency radio waves. Harmful Effects of Radiations Ionizing radiations cause harm due to its high energy. These harm include

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• Mutation of molecules
• Damage of living cells
• Cancer

These radiations results from radioactive substances. Non – ionizing radiations does not penetrate the skin but increases the risk of damage to the skin and eye, depending on the energy and exposure time. Cell phones emit radio waves which are non – ionizing but can cause cancer and other health problems.

B. Climate Change

Climate refers to the statistics of weather over a large period of time. It is measured by assessing the pattern of variation in temperature, humidity, atmospheric pressure, wind, precipitation and other meteorological variables in a given region over a period of time. Climate change or global warming: it is the rise in the average temperature of the earth's climate system. Greenhouse effect: refers to the trapping of the sun's warmth in a planet's lower atmosphere due to greater transparency of the atmosphere to visible radiation from the sun than to the infrared emitted from the planet's surface. Greenhouse gases: refers to some gases in the earth's atmosphere which act a bit like the glass in the greenhouse, allowing short wavelength infrared radiation into the earth and preventing long wavelength infrared radiation from leaving the earth. Greenhouse gases include: water vapour, carbon dioxide, methane, nitrous oxide and fluorinated gases. Causes of Climate Change

•Burning of fossil fuels: Burning of coal, oil and natural gas, solid wastes and wood products to heat buildings, drive vehicles and generate electricity produce CO2 and nitrous oxides.

• Cutting down rainforest (deforestation): Trees absorb CO2 in the process of photosynthesis. Cutting down trees leads to an increased concentration of CO2 in the atmosphere than normal, leading to global warming.

• Use of fertilizers containing nitrogen: this produces nitrous oxides.

Consequences of Global Warming

• The melting of polar ice and glacier and warming of the ocean; this causes rise in sea level, with the consequence of floods.
• Change in rainfall patterns
• Change in average daily temperature
• Increase ocean acidity; due to increase in the amount of CO2 in the atmosphere.

C. Depletion of Ozone Layer

The ozone layer is a region of the atmosphere from 19 to 48 km above the earth's surface. The ozone forms there by the action of sunlight on oxygen.

The ozone layer protects life on earth by absorbing harmful high energy radiations from the sun and cosmic rays (rays from subatomic particles in outer space that travel nearly at the speed of light and carries enormous energy). In recent years, there has been serious concern of destruction of the ozone layer by some chemicals released to the atmosphere such as: chlorofluorocarbons (CFCs, a family of chlorine – containing gases) used as refrigerants, aerosol spray propellants and cleaning agents. New chemicals have been developed to replace CFCs but they are also potential greenhouse gases. They include: hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). Thinning of the ozone layer is predicted to cause increases in skin cancer and cataracts, damage of certain crops etc

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IV. ENERGY CONVERSION SCHEMES

A. Solar energy:

This is energy obtained from sunlight. It consists of electromagnetic radiations ranging from the short wavelength x – rays to the long wavelength radio waves. The Solar Constant It is defined as "the amount of solar energy falling on a unit area on the earth per unit time". It has an average value of 1373 .

The value of solar radiation reaching the earth's surface at any location depends on: • Time of the day

• Geographical location

• Weather conditions

• Season of the year

•Altitude (height above sea level)

To estimate the power output of the sun, the following assumptions are taken into consideration The earth is a perfect sphere The earth is in orbit around the sun at an average distance (= 130 × 10) from the sun's centre.

Advantages of Solar Energy:

• It is a free gift of nature and in abundance

• It is clean i.e. it produces no waste or pollutant

It is renewable i.e. it is inexhaustible

Disadvantages:

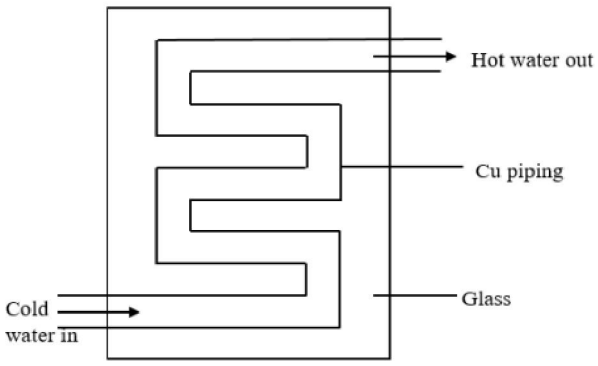
• The intensity of the sun's radiation varies from place to place and from season to season.

• It is unreliable

• The sunshine doesn't follow consumption pattern of consumers, i.e. electricity needed for lighting is needed more in the night where then is no sunlight. Therefore the cost of building a workable solar electricity energy scheme is increased by the cost of the storing device.

Solar Panel: it is used to convert solar energy into electrical energy. Each panel has a blackened surface which absorbs energy directly from solar radiations. They have blackened copper piping on a wooden box covered with a piece of glass.

NB: • The surface of the panel and the copper piping are blackened because black surfaces are good absorbers of thermal and solar radiations. • Solar panels is covered with glass because glass is transparent and permits solar radiations to pass through it. • Solar panels are usually placed at the top of roofs or in exposed areas for maximum exposure to solar radiations. • Solar panels are connected in series so that one panel feeds the other.



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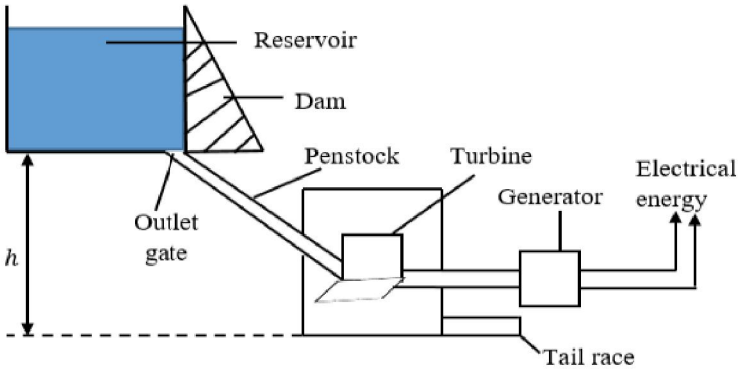
V. METHODOLOGY

A. Hydroelectric Power Plant (HEP)

It is designed to convert the mechanical energy of flowing water into electrical energy. The main features of the power plant include: a reservoir, water passage and the generating unit.

The dam backs up a large quantity of water and releases the water progressively in the generating unit through the penstock. The reservoir also regulates the flow of the river which may vary greatly with season. The reservoir is linked to the turbine by the penstock. The size of the penstock determines the amount of water admitted to the generating unit per unit time and hence the power each unit produces. At the end of the penstock is a spiral casing in which the turbines of the generating unit is placed.



B. Geothermal Energy

This is energy gotten from the earth crust or interior. Deep holes are tunneled through the earth's crust and brine or water is pumped through at high pressures to generate steam which is then used in driving turbines linked to a generators. The kinetic energy of the turbines is changed to electrical energy by the generators.

Advantages

- It is cheap to run 8
- It is a huge source of energy

Disadvantages

- It has a low efficiency
- Cost of installation is high

C. Wind Energy

This is energy obtained from the movement of wind. Energy from the wind can be converted into electrical energy using a wind turbine which consists of rotating blades arranged either vertically or horizontally. During the day, the blades are forced to be rotating and the kinetic energy of the turbine is converted into electrical energy by a generator which is connected t the turbine.

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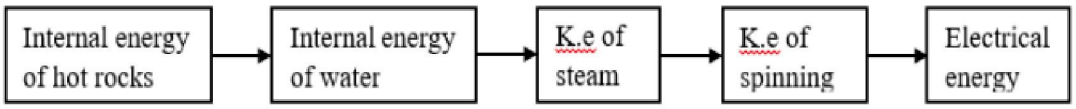

Advantages of Wind Energy

• It is renewable and does not pollute the environment
• It is good for isolated places like farm houses and island.

Disadvantages

• Wind turbines are very inefficient and expensive to setup
• It is unreliable

VI. APPLICATION

Environmental physics can be applied to a number of atmospheric, oceanographic, Earth-system, and solar-terrestrial situations. It may be conceived as the physics connected with analyzing and mitigating environmental problems. Physics plays a broad role, contributing directly to energy production and environmental projects and indirectly through basic research. It is indispensable in addressing the challenge of making a hydrogen economy safe and affordable. Alternative forms of energy production include nuclear power (both nuclear fission and nuclear fusion) and renewable energy (in many forms, including wind, hydropower, photovoltaic cells, and solar thermal energy). Research and development efforts on these alternative technologies are under way around the world

Challenges

Environmental sciences are not usually provided with real laboratories where theories can be tested against experiments, since phenomena often take place only once and cannot be reproduced. The lack of a common language is often a barrier to progress in interdisciplinary subjects such as environmental physics. It is difficult for a physicist with no biological training to communicate with an ecologist.

VII. CONCLUSION

Environmental physics is basically the application of principles of physics to problems in the environment. Physics is the most basic natural science and considers physical systems ranging in size from nuclei, to atoms, to the cosmos. It is an extremely broad field, with many sub-fields. Environmental physics has expanded rapidly, driven by concerns over increasing global carbon dioxide concentrations and changing climate. It increases the awareness of human interactions with the planet. More information about environmental physics can be found in the books in [11-25].

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REFERENCES

[1]. P. Nair, “An introduction to the field of environmental physics,” August 2020, ttps://ysjournal.com/an-introduction-to-thefield-of-environmental-physics.
[2]. Daniel A. Vallero, “Chapter 2: Fundamentals of environmental physics” in Environmental Contaminations, 2004.
[3]. National Research Council, "The environment, " Physics in a New Era: An Overview. Washington, DC: The National Academies Press, chapter 7, 2001.

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[4]. E. Boeker, R. V. Grondelle, and P. Blankert, "Environmental physics as a teaching concept," European Journal of Physics, July 2003.

[5]. "What is a physicist?" Unknown Source "Environmental physics," https://www.utsc.utoronto.ca/admissions/progra ms/environmental-physics

[6]. "Career options after environmental physics," https://utsc.utoronto.ca/aacc/career-options-after-environmental-physics Physics: Planet Earth, Life and Climate. Taylor and Francis, 2001.

[7]. D. Hillel, Environmental Soil Physics. San Diego, CA: Academic Press, 2003.

[8]. K. Forinash, Foundations of Environmental Physics: Understanding Energy Use and Human Impacts. Washington DC: Island Press, 2010.

[9]. P. Singh and T. A. Wani, Basic Environmental Physics. Pragati Prakashan, 2016.

[10]. Encyclopaedia of Introduction to Environmental Physics: Planet Earth, Life and Climate (4 Volumes). Hillingdon, UK: Publisher Koros Press Limited, 2015.

[11]. R. E Robson and D. Blake, Physical Principles of Meteorology and Environmental Physics: Global, Synoptic and Micro Scales. World Scientific Publishing, 2008.

[12]. F. Borghese, P. Denti, and R. Saija, Scattering from Model Nonspherical Particles: Theory and Applications to Environmental Physics. Springer, 2007.

[13]. D. Hillel, Environmental Soil Physics: Fundamentals, Applications, nd Environmental Considerations