

ENVIRONMENTAL EFFECTS OF FOSSIL FUEL USAGE

Idiata, D.J; Omoruyi, F. O.; Agbonlahor, N. N.; and Ohonba, S. U.

Abstract

This paper “Environmental Effects of Fossil Fuel usage” seeks to identify the environmental challenges that are associated with the use of fossil fuel to power machines etc. and the chemical elements causing these environmental problems. The world depends on fossil fuel or energy. This accounts for about 80% to 90% of the world total energy source. Among some of the atmospheric effects of fossil fuel usage are acid rain formations, visibility problems, material damages due to corrosion, photochemical smog formation, global warming, oil spillage etc. These affect the environment adversely and endanger human, plant and the ecosystem. Therefore, there is every need to seek ways to reduce and remedy its effects.

Introduction

The earliest, and, at first, only source of energy used by primitive people was the food they ate. Then, wood fuel fires producing energy for cooking, heat, light and protection from predators. Then animal labour (energy) followed by fossil energy then more recently the nuclear fuel era etc. (Montgomery, 2000).

It is interesting to note that the primary source of energy for planet earth is the sun and the other sources of energy are derived from the sun. The food we eat, the wood we use, the animal are all depend on solar radiation.

Two striking features that characterize energy use trends by humankind in the last 120 years are:

- a) The increase, not only in amount of energy used but also in energy use per person; and
- b) The shifting of the sources from natural sources that uses solar as its primary energy e.g. wood, animal and human energy to fossil fuel i.e. energy stored long ago beneath the earth: coal. gas. petroleum, oil shale and tar sand (Watt, 1973).

Fossil Fuel and its Origin

The term fossil refers to any remains or evidence of ancient life. The fossil fuels, then, are those energy sources that are formed from the remains of once-living organisms (Montgomery, 2000).

Petroleum and natural gas are of marine origin. Photosynthesis in the oceans is estimated to produce 25 billion tons of reduced carbon annually. Most of this is recycled to the atmosphere as carbon dioxide, but a minute fraction settles to the bottom of the ocean, where oxidation is negligible. This biological debris is covered by clay and sand particles, which form a compacted organic layer in a matrix of porous clay or sandstone. The overlying clay column increases in depth thereby increase the temperature and the pressure. As a result, bacterial and other living organism action reduces. Organism disproportion reactions are thought to occur with the release and accumulation of large quantities of methane and hydrocarbons. While coal is based on the decomposition of wood, petroleum is based on the decomposition of marine life (Spiro & Stigliani, 1990).

In a nutshell, the fossil fuels were created from incomplete biological decomposition of dead organic matter (mostly plants and marine organism). When organic matter is buried and escape oxidation, it can be converted by complex chemical reactions in the geologic crust to hydrocarbons (Botkin & Keller, 1998).

However, coals and its varieties (wood, peat, lignite, cannel, bituminous coal and anthracite) range from incomplete biological decomposition of dead plants to completely decomposed (metamorphosed) brilliant anthracite respectively.

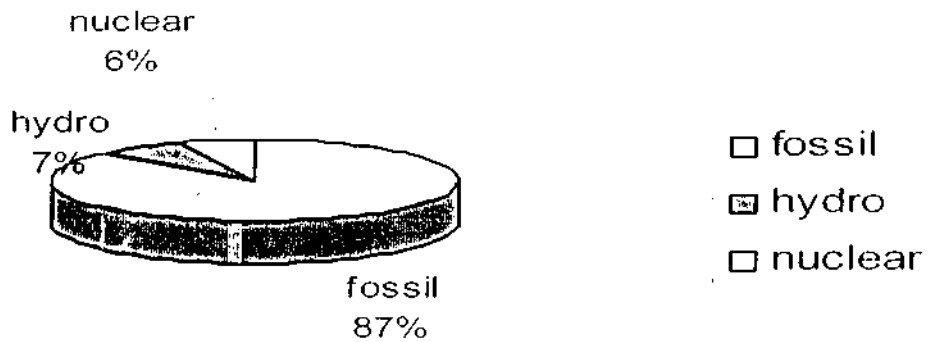
Today's Energy Source

The world today depends on fossil-based fuel for its energy production, use and consumption. This energy base (fossil fuel) is known as a non renewable source of energy because it take a lot of years (millions) to get formed and over the world it is said that it will soon be exhausted. No petroleum is found in rocks younger than 1 to 2 million years old. The pie chart in fig. 1 shows us the 1993 world energy source. From the pie chart in *fig 1* fossil fuel makes up 87 % of the total energy

source, which has made it indispensable to the world energy market. In fact, it is tool in the hands of some

countries of the world for negotiating political matters.

Fig 1: World energy by source, 1993



Situation and Challenges of Fossil Fuel

We are faced with a dilemma-a situation in which a choice must be made between undesirable alternatives in the use of fossil fuel. Fossil fuels provide 90% of the pollution. Continuing reliance on fossil fuels, with the attendant environment problems, is one alternative. The other alternative is to change energy use to other sources such as nuclear energy, hydropower, solar energy, tidal energy, wind energy; geothermal energy biomass etc from the pie chart in *fig. 2* the fossil fuel is made up of petroleum, coal and natural gas, these all make up 89% of the world energy by source.

Fig 2: Global Energy source (IAEA Bulletin, 1993)

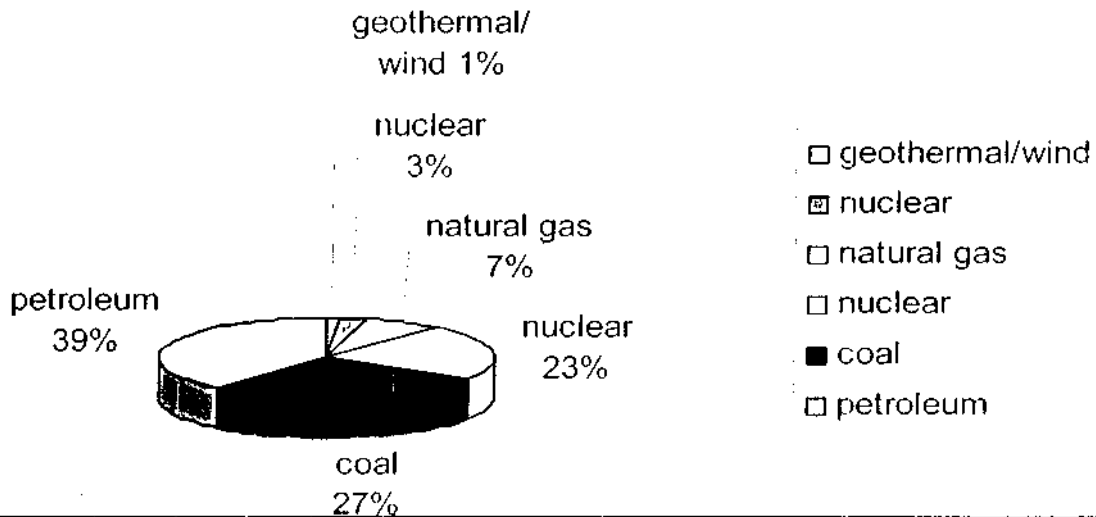


Table 1: Normal Composition of the Atmosphere

Gas	Concentration * or Parts Per Million by Volume (PPmv)
Nitrogen (N ₂)	0.78*
Oxygen (O ₂)	0.21*
Water vapour (H ₂ O)	Variable (0-0.02*)
Carbon dioxide (CO₂)	0.03*
Methane (CH ₄)	1.8
Nitrous oxide (N ₂ O)	0.3
CFCs	0.001
Ozone (O ₃)	Variable (0-1000)
Argon	0.9*
Particulate	0.0001 *

(Source: Houghton, 2002).

The Table above, gives us the composition of the air by volume and from the table nitrogen is the most abundant followed by oxygen. As a matter of fact any reaction that tends to increase or add to any of the elements above in the table will cause a pollution. Such a process will cause a shift in the balance, alteration, or pollution that affects the environment negatively.

Atmosphere Pollution

Atmosphere pollution (air pollution) is due to the presence or alteration of the balance in the composition of the atmospheric elements.

The presence of one or more contaminants in the air in sufficient concentration over a period of time is enough to cause injury to life (human, animal, and plant), damage to materials/properties and it also interfere with normal activities, comfort, heritage etc. (Venugola, 2004).

The burning of fossil fuel does just that. It causes a change in the atmospheric elements composition. It releases the following gases into the atmosphere:

- a) Carbon gases in the form of Carbon monoxide (CO) and Carbon dioxide (CO₂).
- b) Nitrogen gases in the form of Nitrogen oxide (NO), Nitrogen dioxide (NO₂) and Di nitrogen oxide (N₂O).
- c) Ozone is released into the atmosphere.
- d) Particulates in the form of soot, smoke, and ash.
- e) Sulphur gases in the form of Sulphur II oxide (SO₂) and Sulphur III oxide (SO₃).
- f) Lead.

Table 2: Constituent of Major Air Pollutants

Gas	Composition (Percentage)
Carbon monoxide (CO)	45
Oxides of sulphur	13
Particulate matter	15
Oxides of nitrogen	10
Hydrocarbon	12
Others: H ₂ S, HP, MCI, Nil., Pb, Hg, Si, etc.	5

(Source: Goldfarb, 2000).

Table 2, shows us the major air pollutants by their composition in the atmosphere. These pollutants get their way into the atmosphere basically through the burning of fossil based fuel, whether in the presence of sufficient oxygen or not, these pollutants can cause a lot of discomfort and also threaten life.

Environmentology Effects

The results of the release of the above air pollutants into the atmosphere may result to one or more of the following effects on the environment:

Material Damage: The release of acidic oxide gases like CO₂, NO₂, SO₂, SO₃ etc into the atmosphere dissolves into rainwater. When the rain comes in contact with materials like building structure, monuments etc it corrodes them.

Acid Rain: This phenomenon is principally due to the oxides of sulphur from the burning of fossil fuels. Carbon dioxide and Nitrogen oxides also cause acid rain. These gases combine with water in the atmosphere and falls as rain (Agbale et al, 2006).

Acid rains falling into streams and lakes can kill fish and other aquatic organisms. It can acidify soils causing stunted growth in plants; dissolve rocks and causes leaching of the nutrients in the soil. From the table we see that acid rain can reduce the pH of a water to as low as 3.81. If such can be recorded in an advanced country where they are conscious of their environment, there is need to do more to control such phenomenon in the developing countries where there are "no legislation" and control of the environmental waste discharges.

Table 3: Examples of Acidic rain in Southern Norway and Sweden, 1958-1975	
Year	PH
1958	6.0-5.5
1961	5.0-4.5
1966	4.5-4.0
1975	4.6-4.3

Table 4: Selected Sites in New England, 1970

Place	PH
Hubbard Brook, W.H	4.03
Hubbardston, Mass	4.29
Thomaston, Conn.	4.27
New Haven, Conn.	3.81

Sources: (Table 3 & 4): Spiro & Stigliani, 1990.

Visibility Problem: The particulates or particles e.g. Dust, smoke, soot and ash released during burning can cause poor visibility, fog and mist due to the formation or condensation of water around the particles in very low vertical heights. This problem has caused many deaths in transportation e.g. Air disasters, road mishaps and waterway disasters. It can cause great discomfort whether annoyance or psychological and also respiratory disorders and poor photosynthetic activities.

Photochemical Smog: Pollutants such as hydrocarbon and NO_x in the presence of sunlight and ozone cause this.

Formation of photochemical smog reduces visibility and causes irritation, cracking of rubber and

fading of dyes and damages plant and vegetation. It can also cause annoyance and psychological disturbance.

Temperature Inversion: This phenomenon takes place particularly in areas (urban) located in valleys, which are highly industrialized. Air rises upwards when they become warm (kinetic theory of gases), but due to the formation of dense layer of air above the ground level, this leads to a kind of lid formation, which traps the warm air at this lower elevation and prevents its upward movement. This results in the concentration and accumulation of harmful chemicals at ground level from exhausts pipes of both industries and automobiles.

Global Warming (Greenhouse Effects): This phenomenon is caused principally by the presence of Carbon dioxide and Water Vapour in the atmosphere which trap large fraction of the infrared rays emitted from the earth's surface to the atmosphere. This trapped radiation heat thus increases the temperature of the globe causing global warming. However, another phenomenon responsible for global warming is ozone layer depletion.

Oil Spillage: The major causes of oil spill are: blowouts, accidents, pipe rupture, drilling mud deposition, oil seepage. When oil spills, either onto the surface of water or on land it prevents air circulation into the soil voids or water. Because of the absence of oxygen plants and animals, both aquatic and terrestrial are endangered. From report, it is said that the Niger/Delta area in Nigeria is the most threaten and degraded in the world with respect to oil spill. The report further says that the Niger/Delta region of Nigeria has been impacted by 1.5 million tons of crude oil spillage over the last 50 years threatening rare species including primate, fish, turtle, bird, and damaging crops while destroying the livelihood of many of the 20 million people living there. The Niger/Delta is among the live most polluted spots on the face of the earth with dire consequences for the health of inhabitants of the area (Igbikiowubo, 2006).

Flaring: Continuous flaring of the gas in production wells and refineries poses ecological risks to animals. Some animals migrate from such areas to other places. Gas Flaring also contributes to acid rain and other environmental pollution that endangers man, animal, etc.

Recommendations

The following recommendations are deemed lit:

- Afforestation to reduce greenhouse effect.
- Reducing CO₂ emissions.
- Relocating industrial areas from residential areas.
- Improving and increasing the use of renewable energy sources.
- Environmental protection and management should be a priority.
- Reducing the emission of other gas pollutant into the atmosphere.
- Instilling environmental consciousness into individuals, communities, operators and supervisors of industries through training, programmes aimed at reducing environmental pollution.
- Educating the public on waste and indiscriminate fossil fuel burning effects.

Conclusion

The emission of the gases from the burning of fossil fuel into the atmosphere is a big challenge to the government, organizations, industries and the populace.

All organizations have some impact on the natural environment particularly through the resources they use, the processes and activities they undertake, and the waste they generate and create. However, many organizations do not actively seek ways of reducing these impacts. There is deep concern today about uses and particularly the misuses of fossil fuel as it relates to the environment. Our environmental right as human beings include; right to clean air and water, right to forests and seas full of life, right to earth rich in plants and animal life.

References

Agbale, N.R.; Idiata, D.J. and Iyalekhue, L.O. (2006). Environmental chemistry: Impact on water supply quality, international research and development institute, science and technology forum. *Proceedings of Annual Conference*, Vol. 2, No. 3, Nov 22-23. University of Nigeria, Nsukka.

- Botkin, D.B. and Keller, E.A. (1998). *Environmental science: The earth as a living thing, 2nd Edition*. United States, John Wiley & Sons Inc.
- Bulterworth, K.W. (1997). *ISO 14001 environmental handbook*. Heinemann.
- Goldfarb, T.D. (Ed.) (2000). *Notable selection in environmental studies. Second Edition*. Connecticut, Dushkin / McGraw-Hill.
- Houghton, .1. (2002). *Global warming - The complete briefing. Second Edition*. United Kingdom, Cambridge University Press. *IAEA Bulletin* 1993, No 4, Pp. 23.
- Igbikiowubo, 11. (2006, October 3 I) *Vanguard Newspaper*. Vol. 22: No: 60191, Pp. 1 9.
- Montgomery, C.W. (2000). *Environmental geology - Updated. Fifth Edition*. McGraw-Hill Higher Education.
- Rao, P.V. (2004). *Textbook of environment engineering*. New Delhi: Prentice-Hall of India Private Limited.
- Spiro, T.G. and Stigliani, W.M. (1990). *Environmental issues in chemical perspective*. Iowa: Kendall/Hunt Publishing Company.
- Watt, K.E.F. (1973). *Principal of environmental science*. Iowa: McGraw-Hill Book Company.