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FOSSIL FUEL - BIOFUEL: ENVIRONMENTAL CONSIDERATIONS VERSUS COST IMPLICATIONS

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ABSTRACT
Population growth has resulted in ever increasing demand for energy usage. The traditional fossil fuels resources are depleting day by day. The world is confronted with the twin crises of fossil fuel depletion and environment degradation. The need for lower energy prices and environment security has prompted today scientists to look for alternative fuels which can be produced from materials that are widely available from a variety of sources. This paper reviews the various types of fossil fuels, Bio fuels and their feed stocks, and their environmental and cost implications. Thus, presenting the choices in a better perspective. Solutions to curbing the high cost of Bio fuel production are also highlighted in this paper.
Keywords: crude oil, fossil fuel, biofuel, renewable, biomass, feedstock.

INTRODUCTION
With an estimated population size of over six billion and a hundred and fifty million for Nigeria, issues surrounding energy is of great concern and shall continue to be. This is because population explosion has given rise to economic growth, unprecedented technological advancement, and increase in types and means of transportation. All these no doubt translate into a huge challenge on our energy source, means of generation, cost and the side effects that can arise from it all. Therefore, there is every need to constantly consider and review our energy policies, types, source, efficiency and their environmental effect. This is most important for developing countries like ours-Nigeria if we must grow like other nations in the committee of nations and be able to meet our energy needs, play a role as a force in the provision of energy in today's world. This review paper is geared towards the evaluation of our energy sources and environmental implication of two types of fuels – fossil fuel and bio fuel. However, because of the increasing need for energy and the role it plays in the outworking of human development, fossil fuel being non renewable, has given rise to the search for renewable energy sources. This work is devoted to analysing these energy sources and the environmental and cost effect of both types of fuel.

FOSSIL FUEL
These are non- renewable resources because they take millions of years to form, and reserves are being depleted much faster than new ones are being made. They are formed by natural resources such as anaerobic decomposition of buried dead organisms. The age of the organisms and their resulting fossil fuel is typically millions of years and sometimes exceeds six hundred and fifty million years[5]. Fossil fuels include petroleum, coal, and natural gas which contain high percentage of carbon. It was estimated by the Energy Information Administration that in 2007 alone, primary sources of energy consisted of

petroleum 36.0%, coal 27.4%, and natural gas 23.0%, amounting to an 86.4% share for fossil fuels in primary energy consumption in the world[1] The burning of fossil fuels produces around 21.3 billion tonnes (21.3 gigatonnes) of carbon dioxide per year, but it is estimated that natural processes can only absorb about half of that amount, so there is a net increase of 10.65 billion tonnes of atmospheric carbon dioxide per year[2]. Carbon dioxide is one of the green gases that contribute immensely to global warming, causing the average surface temperature of the earth to rise in response, which climate scientist agree will cause major adverse effects. Consequently, a global movement towards the generation of renewable energy that is environmentally friendly is underway to help meet increasing energy needs.

TYPES OF FOSSIL FUELS

Types of fossil fuel fuels include – crude oil, natural gas and coal.

CRUDE OIL

his is a naturally occurring, toxic flammable liquid consisting of a complex mixture of hydrocarbons of various molecular weight and other organic compounds that are found in geological formations beneath the earth's surface [3]. It is recovered mostly through oil drilling. Its refined and separated most easily with the aid of the boiling point of its fractions like Gasoline and kerosene and other products like plastics, chemical reagent and pharmaceuticals can be obtained from it[4]. Crude oil in the reservoir, is associated with natural gas (associated gas) and principally consist of heavier hydrocarbons such as pentane, hexane and heptanes .Under surface pressure and temperature, the lighter hydrocarbons like methane ,ethane ,propane and butane occur as gases, while heavier ones from pentane are in the liquid or solid state. However, in the underground oil reservoir, the proportion which is gas or liquid depending on the subsurface condition, and on the phase diagram of the petroleum mixture[5]. Other organic compounds contained in crude oil are nitrogen, oxygen and oxygen and sulphur along with trace amounts of metals such as iron, nickel, copper and vanadium. The exact molecular composition varies widely from formation to formation but the proportion of chemical elements vary over fairly narrow limits as follows

Table 1: Composition by weight of crude oil

Element	Percentage composition
Carbon	83 – 87%
Hydrogen	10 -14%
Nitrogen	0.1 %2
Oxygen	0.1 -1.5%
Sulphur	0.5 – 6%
Metals	<0.1%

Four different types of hydrocarbon molecules appear in crude oil as shown below;

Table 2: Percentage composition major components of crude oil

Element	Average	Range
Paraffins	30%	15 – 60%
Naphthenes	49%	30 -60%
Aromatics	15%	3 – 30%
Aspaltics	6%	Remainder

Their appearance varies from black to dark brown, although it may be yellowish, reddish or even greenish.

Certain empirical equations are used to describe the thermal behaviour of crude oil products as shown below; [6]

1. Heat of combustion: At constant volume, the heat of combustion of crude oil products can be approximated as ;

   $Q_{v=12,400-2,100d^2}$

   Where Q_v is measured in cal/gram and d is the specific gravity at 60^oF

2. Thermal conductivity: The thermal conductivity of petroleum based liquids can be modelled as follows;

   $K = \frac{0.813}{d}[1 - 0.0203(t - 32)]$

Where K is measured in $BTU.hr^{-1}Ft^{-2}$, t is measured in ^oF and d is the specific gravity at 60^oF

3. Specific heat: The specific heat of petroleum oils can be modelled as follows;

$$C = \frac{1}{\sqrt{}}[0.388 + 0.00045t]$$

Where C is measured in BTU/lbm – ^oF, t is the temperature in Fahrenheit and if the specific gravity at 60^oF is in units of Kcal/Kg ^oC, the formula is;

$$\frac{1}{\sqrt{d}}[0.402 + 0.00081t]$$

Where the temperature t is in Celsius and d is the specific gravity at 15^oC.

4. Latent heat of vaporization: The latent heat of vaporization can be modelled under atmospheric conditions as follows;

$$L = \frac{1}{d}[110.9 - 0.9t]$$

   Where L is measured in BTU/lbm, it is measured in ^oF and d is the specific gravity at 60^oF. In units of Kcal/Kg, the formula is

$$L = \frac{1}{d}[194.4 - 0.162t]$$

   Where the temperature t is Celsius and d is the specific gravity at 15^oC

EXPLORATION PROCESSES AND METHODS

Crude oil exploration is the search by petroleum geologists and geophysicists for deposits beneath the earth's surface. Visible surface features such as oil seeps, natural gas seeps, pockmarks (underwater craters caused by escaping gas) provide basic evidence of hydrocarbon generation (be it shallow or deep in the earth). However, most exploration depends on highly sophisticated technology to detect and determine the extent of this deposit using exploration geophysics. Areas thought to contain hydrocarbon are initially subjected to a gravity survey, magnetic survey passive seismic or regional seismic reflection surveys to detect large scale features of the sub-surface geology. Finally, when prospect has been identified and passes the oil company's selection criteria, an exploration well is drilled in an attempt to conclusively determine the presence of oil or gas [7].

PROCESSING AND USES

The core refining process is simple distillation. Because crude oil is made up of a mixture of hydrocarbons, this first and basic refining process is aimed at separating the crude oil into its "fractions," the broad categories of its component hydrocarbons. Crude oil is heated and put into a still -- a distillation column -- and different products boil off and can be recovered at different temperatures. The lighter products -- liquid petroleum gases (LPG), naphtha, and so-called "straight run" gasoline -- are recovered at the lowest temperatures. Middle distillates -- jet fuel, kerosene, distillates (such as home heating oil and diesel fuel) -- come next. Finally, the heaviest products (residuum or residual fuel oil) are recovered, sometimes at temperatures over 1000 ^{0}F. The simplest refineries stop at this point. Most in the United States, however, reprocess the heavier fractions into lighter products to maximize the output of the most desirable products, as shown schematically in the illustration, and as discussed below[8].

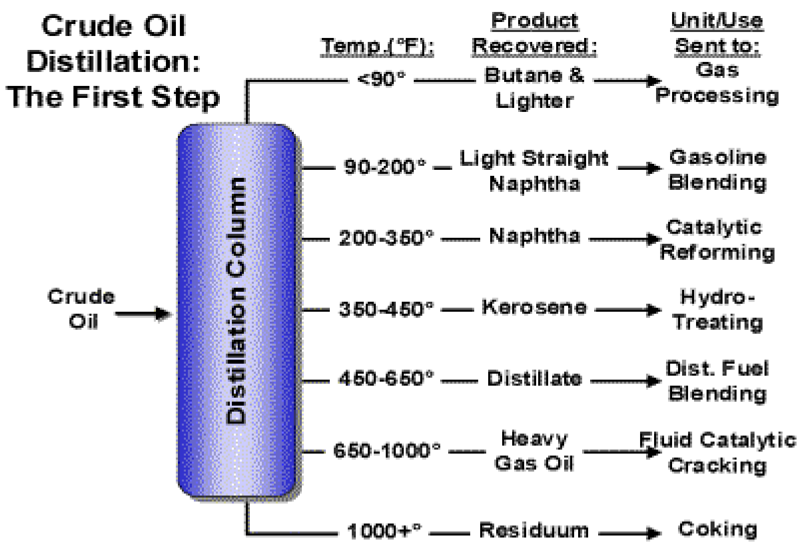

Fig1: Crude oil distillation steps

COMMON PROCESSES FOUND IN REFINERY

- Desalter unit: washes out salt from the crude oil before it enters the atmospheric distillation unit.
- Atmospheric distillation: unit distills crude oil into fractions. See Continuous distillation.
- Vacuum distillation unit further distills residual bottoms after atmospheric distillation.
- Naphtha hydrotreater: unit uses hydrogen to desulfurize naphtha from atmospheric distillation. Must hydrotreat the naphtha before sending to a Catalytic Reformer unit.
- Catalytic reformer: unit is used to convert the naphtha-boiling range molecules into higher octane reformate (reformer product): the reformate has higher content of aromatics and cyclic hydrocarbons). An important byproduct of a reformer is hydrogen released during the catalyst reaction. The hydrogen is used either in the hydrotreaters or the hydrocracker.

- Distillate hydrotreater unit desulfurizes distillates (such as diesel) after atmospheric distillation.
- Fluid catalytic cracker (FCC) unit: upgrades heavier fractions into lighter, more valuable products.
- Hydrocracker unit: uses hydrogen to upgrade heavier fractions into lighter, more valuable products.
- Visbreaking unit: upgrades heavy residual oils by thermally cracking them into lighter, more valuable reduced viscosity products.
- Merox unit: treats LPG, kerosene or jet fuel by oxidizing mercaptans to organic disulfides.
- Coking units (delayed coking, fluid coker, and flexicoker) process very heavy residual oils into gasoline and diesel fuel, leaving petroleum coke as a residual product.
- Alkylation unit produces high-octane component for gasoline blending.
- Dimerization unit converts olefins into higher-octane gasoline blending components. For example, butenes can be dimerized into isooctene which may subsequently be hydrogenated to form isooctane. There are also other uses for dimerization.
- Isomerization unit: converts linear molecules to higher-octane branched molecules for blending into gasoline or feed to alkylation units.
- Steam reforming unit: produces hydrogen for the hydrotreaters or hydrocracker.
- Liquified gas storage units store propane and similar gaseous fuels at pressure sufficient to maintain them in liquid form. These are usually spherical vessels or bullets (horizontal vessels with rounded ends.
- Storage tanks store crude oil and finished products, usually cylindrical, with some sort of vapor emission control and surrounded by an earthen berm to contain spills.
- Slug catcher used when product (crude oil and gas) that comes from a pipeline with two-phase flow, has to be buffered at the entry of the units.
- Amine gas treater, Claus unit, and tail gas treatment convert hydrogen sulfide from hydrodesulfurization into elemental sulfur.
- Utility units such as cooling towers circulate cooling water, boiler plants generates steam, and instrument air systems include pneumatically operated control valves and an electrical substation.
- Wastewater collection and treating systems consist of API separators, dissolved air flotation (DAF) units and further treatment units such as an activated sludge biotreater to make water suitable for reuse or for disposal
- Solvent refining units use solvent such as cresol or furfural to remove unwanted, mainly asphaltenic materials from lubricating oil stock or diesel stock.
- Solvent dewaxing units remove the heavy waxy constituents petrolatum from vacuum distillation products

PRODUCTS/USES

Petroleum products are usually grouped into three categories: light distillates (LPG, gasoline, naphtha), middle distillates (kerosene, diesel), heavy distillates and residuum (heavy fuel oil, lubricating oils, wax, asphalt). This classification is based on the way crude oil is distilled and separated into fractions (called distillates and residuum) as in the above drawing[9].

- Liquified petroleum gas (LPG)

- Gasoline (also known as petrol)
- Naphtha
- Kerosene and related jet aircraft fuels
- Diesel fuel
- Fuel oils
- Lubricating oils
- Paraffin wax
- Asphalt and tar
- Petroleum coke

SPECIALTY END PRODUCTS

- Gaseous fuels such as propane stored and shipped in liquid form under pressure.
- Liquid fuels blending (producing automotive and aviation grades of gasoline, kerosene, various aviation turbine fuels, and diesel fuels, adding dyes, detergents, antiknock additives, oxygenates, and anti-fungal compounds as required).
- Lubricants (produces light machine oils, motor oils, and greases, adding viscosity stabilizers as required).
- Wax (paraffin), used in the packaging of frozen foods, among others.
- Sulfur (or sulfuric acid), byproducts of sulfur removal from petroleum which may have up to a couple percent sulfur as organic sulfur-containing compounds. Sulfur and sulfuric acid are useful industrial materials. Sulfuric acid is usually prepared and shipped as the acid precursor oleum.
- Bulk tar shipping for offsite unit packaging for use in tar-and-gravel roofing.
- Asphalt unit. Prepares bulk asphalt.
- Petroleum coke, used in specialty carbon products or as solid fuel.
- Petrochemicals or petrochemical feedstocks, which are often sent to petrochemical plants for further processing in a variety of ways. The petrochemicals may be olefins or their precursors, or various types of aromatic petrochemicals.

NATURAL GAS

Natural gas is a gas consisting primarily of methane. It can be found in pure gas reservoirs as non associated gas, with other fossil fuels like crude oil (as associated gas) or coal beds as methane clathrates. It is created by methanogenic organisms in marshes, bogs and landfills. It is an important fuel source, and a potent greenhouse gas[10]**.** Before natural gas can be used as a fuel, it must undergo extensive processing to remove almost all materials other than methane. The by-products of that processing include ethane, propane, butanes, pentanes, and higher molecular weight hydrocarbons, elemental sulfur, carbon dioxide, water vapor, and sometimes helium and nitrogen.

As mentioned above, natural gas exists as associated and non associated gas. In the associated form with crude oil, it is produced as a by product of producing oil, since the small, light gas carbon chains come out of solution as it undergoes pressure reduction from the reservoir to the surface, similar to uncapping a bottle of soda pop where the carbon dioxide effervesces. Before now, unwanted natural gas disposal has been a problem since there is not enough market for it near the wellhead and it has to be piped to the end users which is capital intensive. Therefore, they are flared and this obviously degrades the environment. One way out of this is to pump back into the reservoir unwanted or stranded gas (gas without market) with the use of an injection well for disposal or re – pressurizing the producing formation.

Another solution is to export the natural gas as a liquid[11]. Gas-to-liquid, (GTL) is a developing technology that converts stranded natural gas into synthetic gasoline, diesel or jet fuel through the Fischer-Tropsch process developed in World War II Germany. Such fuels can be transported through conventional pipelines and tankers to users. Proponents claim GTL fuels burn cleaner than comparable petroleum fuels. Most major international oil companies are in advanced development stages of GTL production, with a world-scale (140,000 barrels a day) GTL plant in Qatar scheduled to come online before 2010[10] and the Nigeria's liquefied natural gas (NLNG) plant in full operation while the Escravos gas to liquid (EGTL) project in advanced stage.

NATURAL GAS PROCESSING

Below is a schematic diagram showing the steps involve in the processing of natural gas. It shows the various unit processes used to convert raw natural gas into sales gas pipelined to the end user markets.

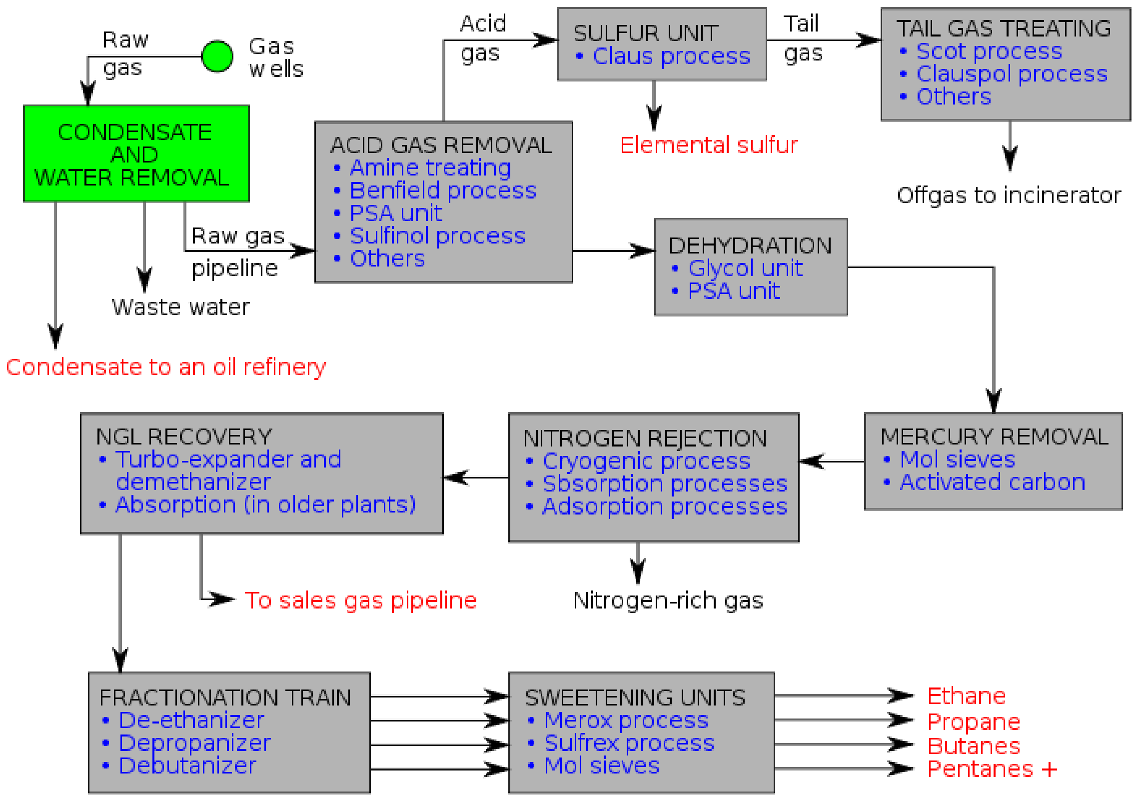

Fig.2: Natural gas processing

USES OF NATURAL GAS

Natural gas can be used in various ways these are;

Power generation

Natural gas is a major source of electricity generation through the use of gas and steam turbines. Most grid peaking power plants and some off-grid engine-generators use natural gas. Particularly high efficiencies can be achieved through combining gas turbines with a steam turbine in combined cycle mode. Natural gas burns more cleanly than other fossil fuels, such as oil and coal, and produces less carbon dioxide per unit energy released. For an equivalent amount of heat, burning natural gas produces about 30% less carbon dioxide than burning petroleum and about 45% less than burning coal[12]. Combined cycle power generation using natural gas is thus the cleanest source of power available using fossil fuels, and this technology is widely used wherever gas can be obtained at a reasonable cost. Fuel cell technology may eventually provide cleaner options for converting natural gas into electricity, but as yet it is not price-competitive

Transportation

Natural gas in the compressed form called compressed natural gas (CNG) is used to fuel automobiles. It is a much cleaner alternative to automobile fuel such as gasoline (petrol) and diesel. As of 2008 there were 9.6 million natural gas vehicles worldwide, led by Pakistan (2.0 million), Argentina (1.7 million), Brazil (1.6 million), Iran (1.0 million), and India (650,000)[12]. The energy efficiency is generally equal to that of gasoline engines, but lower compared with modern diesel engines. Gasoline/petrol vehicles converted to run on natural gas suffer because of the low compression ratio of their engines, resulting in a cropping of delivered power while running on natural gas (10%-15%). CNG-specific engines, however, use a higher compression ratio due to this fuel's higher octane number of 120–130[12].

Fertilizers

Natural gas is a major feedstock for the production of ammonia, via the Haber process, for use in fertilizer production.

Hydrogen

Natural gas can be used to produce hydrogen, with one common method being the hydrogen reformer. Hydrogen has various application; It is a primary feedstock for the chemical industry, a hydrogenating agent, an important commodity for oil refineries, and a fuel source in hydrogen vehicles.

Others: Natural gas is also employed in the manufacture of fabrics, glass steel, plastics, paints, and other products.

COAL

Another type of fossil fuel is coal. It is a black or brownish, readily combustible rock normally occurring in rock strata in layers or veins called beds. The harder forms, such as anthracite coal, can be regarded as metamorphic rock because of later exposure to elevated temperature and pressure. Coal is composed primarily of carbon along with variable quantities of other elements, chiefly sulfur, hydrogen, oxygen and nitrogen[13].

Coal begins as layers of plant matter accumulate at the bottom of a body of water. For the process to continue the plant matter must be protected from biodegradation and oxidization, usually by mud or acidic water. The wide shallow seas of the Carboniferous period provided such conditions. This trapped atmospheric carbon in the ground in immense peat bogs that eventually were covered over and deeply buried by sediments under which they metamorphosed into coal. Over time, the chemical and physical properties of the plant remains (believed to mainly have been fern-like species antedating more modern plant and tree species) were changed by geological action to create a solid material.

Coal, a fossil fuel, is the largest source of energy for the generation of electricity worldwide, as well as one of the largest worldwide anthropogenic sources of carbon dioxide emissions. Gross carbon dioxide emissions from coal usage are slightly more than those from petroleum and about double the amount from natural gas. Coal is extracted from the ground by mining, either underground or in open pits[13].

TYPES OF COAL

Under suitable conditions, coal is transformed into different types, these are;

- Peat, considered to be a precursor of coal, has industrial importance as a fuel in some regions, for example, Ireland and Finland. In its dehydrated form, peat is a highly effective absorbent for fuel and oil spills on land and water
- Lignite, also referred to as brown coal, is the lowest rank of coal and used almost exclusively as fuel for electric power generation. Jet is a compact form of lignite that is sometimes polished and has been used as an ornamental stone since the Iron Age
- Sub-bituminous coal, whose properties range from those of lignite to those of bituminous coal is used primarily as fuel for steam-electric power generation. Additionally, it is an important source of light aromatic hydrocarbons for the chemical synthesis industry.
- Bituminous coal, dense mineral, black but sometimes dark brown, often with well-defined bands of bright and dull material, used primarily as fuel in steam-electric power generation, with substantial quantities also used for heat and power applications in manufacturing and to make coke
- *Steam coal* is a grade between bituminous coal and anthracite, once widely used as a fuel for steam locomotives. In this specialized use it is sometimes known as *sea-coal* in the U.S[13]. Small steam coal (*dry small steam nuts* or DSSN) was used as a fuel for domestic water heating
- Anthracite, the highest rank; a harder, glossy, black coal used primarily for residential and commercial space heating. It may be divided further into metamorphically altered bituminous coal and *petrified oil*, as from the deposits in Pennsylvania

Graphite, technically the highest rank, but difficult to ignite and is not so commonly used as fuel: it is mostly used in pencils and, when powdered, as a lubricant.

USES OF COAL

Coal has found application in various areas; these not limited to are;

1. As solid fuel to produce electricity and heat through combustion.
2. For cooking
3. Ethanol production
4. Gasification to produce syngas (a mixture of carbon monoxide (CO) and hydrogen (H_2) gas which can be converted into transportation fuels like gasoline and diesel through the Fischer- Tropsch process.

BIOFUEL

These are defined as solids, liquid or gaseous fuels obtained from relatively recent lifeless or living biological materials which can be regenerated. These renewable biological materials are called biomass. Examples of this are ethanol, biogas, biodiesel etc.[14].

BIOFUEL FEEDSTOCKS

Biofuel feedstocks are the organic materials used in the production of biofuels such as Biomethane or Renewable Natural gas, Biodiesel and Bio ethanol. They includes grass, leaves, corn, sugar beets, sugar cane, crude canola oil,crude coconut oil, crude Jatropha oil, crude palm oil, crude rapeseed oil etc[15]. For Biodiesel production the feedstock is usually a triglyceride (fat/oil) with an alcohol usually methanol to form methy esters and glycerol[16]. The reaction between the triglyceride and the methanol to form a methyl ester (Biodiesel) in the presence of a catalyst is termed transesterification[17,18]. For renewable natural gas (Biogas), or Bioethanol, the feedstock could be corn, rice, sugar cane, grass, leaves, animal dung etc. Biofuels will worsen Global Food crisis depending on the type of feedstock used[19]. The world is now fighting against feedstocks which compete with food production or leads to increase in food prices. Biofuel feedstocks such as Jatropha oil, waste vegetable oil, neem oil, water hyacinths, elephant grass, cow dung, microorganisms which are not edible are now being encouraged [20]. Whereas the first generation of biofuels were made from edible sugars and starches, the second and third generation biofuels are now being made from non-edible plant materials; algae and microbes[10]. Unrefined and used oil can also be used as biodiesel production feedstock with enzymatic/acid catalysed transesterification to give quality product which will meet the ASTM standard[22].

TYPES

There are different types of biofuels depending on their state and mode of manufacture. These are;[23]

FIRST GENERATION BIOFUELS

These are biofuels made from sugar, starch, vegetable oil or animal fats using conventional technology. The basic feedstocks for the production of first generation biofuels are often seeds or grains such as wheat, which yields starch that is fermented into bioethanol, or sunflower seeds, which are pressed to yield oil that can be used in biodiesel. These feedstocks could instead enter the animal or human food chain, and as the global population has risen, their use in producing biofuels has been criticised for diverting food away from the human food chain, leading to food shortages and price rises. Those fuel in this group include;

Bioethanol

Ethanol (an alcohol) - is currently made primarily from the starch or corn grain. It's most commonly used as an additive for petroleum based fuels to reduce toxic air emissions and increase octane. Today, around one – third of the gasoline solid in the US includes 5% - 10% ethanol [1]. Ethanol are normally obtained from carbohydrate in biomass as shown

$$\text{Starch} \xrightarrow[+H_2O]{Invertase} \text{Maltose } (C_{12}H_{22}O_n) \xrightarrow[H_2O]{Maltase} \rightarrow \text{Glucose } (C_6H_{12}O_6) \xrightarrow{Zymase} 2CO_2 + 2C_2H_5OH$$

$$\text{Molases (Sugar cane waste)} \xrightarrow{diastase} \text{Glucose} + \text{Maltose} \xrightarrow{Zymase} 2CO_2 + 2C_2H_5OH$$

$$\text{Cellulose} \xrightarrow{Invertase} \text{Sucrose} \xrightarrow{diastase} \text{Glucose} + \text{Fructose} \xrightarrow{Zymase} CO_2 + C_2H_5OH$$

Biodiesel

is made primarily from soybean oil. Its use is currently relatively small, but its benefits to air quality are quite dramatic. They are typically blended at 20% with petroleum diesel [9]. It is produced from oils using trans-esterification and is a liquid similar in composition to fossil / mineral diesel. Its chemical name is fatty acid methyl (or ethyl) ester (FAME). Oils are mixed with sodium hydroxide and methanol (ethanol) [1] and the chemical produces are biodiesel, and glycerol. One part glycerol is produced for every 10 parts biodiesel. Feed stocks for biodiesel include animal fats, vegetable oil, soybean rapeseed, jatropha, machua, mustard, flax, sunflower, palm oil, hemp, field pennycress, pongamia pinnata and algae. Pure biodiesel (B100) is by far the lowest emission diesel fuel. Although liquefied petroleum gas and hydrogen have cleaner combustion, they are used to fuel much less efficient petrol engines and are not as widely available .

Biodiesel can also be used in any diesel engine when mixed with mineral diesel. Majority of manufacturers recommend up to 15% biodiesel blended with mineral diesel. Biodiesel is also found to be an effective solvent and cleans residues deposited by mineral diesel, as the biofuels dissolve old deposits on the fuel tankers and pipes. It also effectively cleans the engine combustion chamber of the carbon deposits helping to maintain efficiency. Biodiesel is also an oxygenated fuel, meaning that it contains only a small amount of carbon and higher hydrogen and oxygen content than fossil fuel. This improves the combustion of fossil diesel and reduces the particulate of emissions of unburnt carbon. It is safe to handle and transport because it is as biodegradable as sugar,10 times less toxic than table salt and has a high flash point of about 300 F (148°C) compared to fossil fuel in petroleum diesel fuel, which has a flash point of 125F (52°C)[24]

Bioethers

They are also referred to as fuel ethers or fuel oxygenates. They are cost effective compounds that act as octane rating enhancers. They also enhance engine performance, whilst significantly reducing engine wear and toxic exhaust emissions. Greatly reducing the amount of grand level ozone, they contribute to the quality of air we breathe.[25]

Biogas

Biogas is produced by the process of anaerobic digestion of organic material by anaerobes[26]. It can be produced either from biodegradable waste materials or by the use of energy crops fed into anaerobic digesters to supplement gas yields. The solids bye product, digestate can be used as biofuel or a fertilizer. Biogas contains methane and can be recovered from industrial anaerobic digesters and mechanical biological treatment systems. Land fill gas is a less clean form of biogas which is produced in landfills through naturally occurring anaerobic digestion. If it escapes into the atmosphere it is a great potent green gas.

Solid Biofuels

These include wood, Grass, cuttings, domestic refuse, charcoal, agricultural waste, non food energy and dried manure. When raw biomass is already in a suitable form, it can burn directly in a stove or furnace to provide heat or raise steam. When raw, biomass an inconvenient form (such as saw dust, wood chips, grass, urban waste wood, agricultural residues), the typical process includes grinding the raw biomass to an appropriate particulate size (known as hogfuel) which depending on the densification type can form 1 to 3 cm which is then concentrated into a fuel product. The current types of process include pellet, cube or puck. The resulting densified fuel is easier to transport and feed into thermal generation system such as boilers. A problem with the combustion of raw biomass is that it emits considerable amount of pollutants such as particulates and polycyclic aromatic hydrocarbon (PAHS). Even modern pellet boilers generate much more pollutants than oil or natural gas boilers. Pellets made from agricultural residues are usually worse than emissions of dioxins and chorophenols[27] .

SECOND GENERATION BIOFUELS

These are biofuels derived from non food crops. Their production processes can use a variety of non food crops. These include waste biomass, the stalks of wheat, corn, wood and special- energy or biomass crops e.g miscantus. They use biomass to liquid technology [28] including cellulosic biofuels from non-food crops.Many second generation biofuels are under development such as biohydrogen, bioethanol, DMF, BioDME,Fischer-Tropsch diesel, biohydrogen diesel, mixed alcohol and wood diesel. Cellulosic ethanol production uses non food crops or inedible waste products and does not divert food away from the animal or human food chain. Lignocellulose is the 'woody' structural material of plants. This feed stock is abundant and diverse and some cases (like citrus peels or sawdust) it is itself a significant disposal problem.

THIRD GENERATION BIOFUELS

Algae fuels also called oilgae or third generation biofuels is a biofuel from algae. Algae are low input, high input feed stocks to produce biofuels. Based on laboratory experiments, it is claimed that algae can produce 30 times more energy per acre than land crops such as soybeans(Eviana Hartman, 2008) but these yields have yet to be produced commercially. One advantage of many biofuels over most other fuel types is that they are biodegradable, and so relatively harmless to the environment if spilled. Algae fuel still has its difficulties though, for instance to produce algae fuel it must be mixed uniformly, which if done by agitation, could affect biomass growth (General one file. Gale. 2009). The US Department of Energy estimates that if algae fuel replaced all the petroleum fuel in the US, it will require 15,000 square miles (38,849 square kilometres), which is roughly the size of Marylands[29]

ENVIRONMENTAL EFFECT OF FOSSIL FUELS

There is a growing concern regarding the collaboration between fossil fuels and environmental pollution. Debates regarding this contamination have become commonplace in today's effort to sustain the earth's health. Fossil fuels are not considered a renewable energy source and aside from the environmental impact, the cost of retrieving and converting them is beginning to demand notice. Seemingly this issue has many different angles that need to be addressed in order to ensure future generations a sustainable living. Combustion of these fossil fuels is considered to be the largest contributing factor to the release of greenhouse gases into the atmosphere. In fact it is believed that energy providers are the largest source of atmospheric pollution today.

There are many types of harmful outcomes which result from the process of converting fossil fuels to energy. Some of these include air pollution, water pollution, accumulation of solid waste, not to mention the land degradation and human illness.

Evidence of the ill effects of fossil fuels is endless, and can take on many forms. Some forms are not easily seen by the human eye, although the disastrous results such as the loss of aquatic life can be seen somewhat after the fact. Carbon dioxide is considered the most prominent contributor to the global warming issue. The impact of global warming on the environment is extensive and affects many areas. In the Antarctica, warmer temperatures may result in more rapid ice melting which increases sea level and compromises the composition of surrounding waters. Rising sea levels alone can impede processes ranging from settlement, agriculture and fishing both commercially and recreationally.

Air pollution is another problem arising from the use of fossil fuels, and can result in the formation of smog. Other than causing human illness, smog can also affect the sustainability of crops. Smog seeps through the protective layer on the leaves and destroys essential cell membranes. This result in smaller yields and weaker crops, as the plants are forced to focus on internal repair and do not thrive. Many toxic substances are released during the conversion or retrieval process including "Vanadium" and "Mercury". According to the "New Book Of Popular Science", "it is suspected that significant quantities of Vanadium in the atmosphere results from residual fuel oil combustion".
When coal is burned, it releases nitrous oxide. Unfortunately this is kept in the atmosphere for very long time. The harmful impact of this chemical could take up to a couple of hundred years to make itself known. It is very difficult to prevent or to diminish an impact when you are not even aware of what it may be. The only solution in this case is to reduce the formation of nitrous oxide. Nearly 50% of the nitrogen oxide in the atmosphere and 70% of sulfur dioxide are direct result of emissions released when coal is burned.

Converting fossil fuels may also result in the accumulation of solid waste. This type of accumulation has a devastating impact on the environment. Waste requires adequate land space for containment and/or treatment, as well as financial support and monitoring for waste not easily disposed of. This type of waste also increases the risk of toxic runoff which can poison surface and groundwater sources for many miles. Toxic runoff also endangers surrounding vegetation, wildlife, and marine life. Delivery of fossil fuels can result in oil spills, and many of us are familiar with the impacts of this type of disaster. Seepage from foundations like that of oil rigs and pipelines can also result in similar destruction for habitat and wildlife. According to the American Department Of The Interior, vast damage to waterways can be attributed to the extraction of coal. Coal extraction may very well be the leading the source of water pollution today[29]. Use of unleaded gas has helped to reduce the release of lead into the environment. Although in third world countries, the safer unleaded gas has not been fully utilized and is still a major concern. Unfortunately for developing countries, the economy and technology available to them is quite behind what the developed nations are used to. With this in mind many environmental issues are treated at an international level, which allows for more efficient handling.

We have become a very energy greedy generation and our demands for electricity are very high. As far as reducing these harmful effects, we must first reduce our demand. Science may be able to find alternative, healthier sources, although not ones that meet the required supply. These types of horrendous impacts are felt globally and should not be considered one countries problem. Sometimes social limitations and/or economic stability can make the process of change very difficult. One thing is for sure, that by being more energy efficient and conservative, we will be helping to alleviate the toll on environmental and human health.

BIOFUEL PRODUCTION COST, IMPLICATIONS AND SOLUTIONS

A major hurdle facing commercial biodiesel production is the cost of producing the fuel 75% - 80% of the cost of producing biodiesel arise from oil seed procurement, transport, seed storage, and oil extraction [30,31]. The cost varies depending on the feedstock used[17]. The use of lower cost organic oil feedstock such as waste food processing oil or tallow, non-edible seeds would reduce the production cost of biodiesel and biodiesel blended fuel[21]. A blended fuel of 20 percent biodiesel and 80 percent petroleum diesel could also reduce cost. The cost of producing ethanol from corn is estimated to be higher than fossil fuel gasoline. However, when 10 percent ethanol and 90 percent gasoline are blended, the blended fuel becomes competitive due to a 5.4 percent less per gallon tax than straight gasoline in the market. This stimulates the growth of ethanol production and distribution[30]. The cost of biodiesel can also be reduced by the use of an appropriate catalyst for instance heterogeneous catalyst. The use of heterogeneous catalyst in biodiesel production helps to eliminate the additional cost of product purification which is common with homogeneous catalyst[31]. Biogas an ecological biofuel that may replace firewood present a viable option especially in countries threatened by desertification[14]. Due to the high cost of petroleum products and electricity, utilization of biomass which cost little or nothing to produce energy for modern use represents a good opportunity and a credible alternative[32]. Biogas may not cost anything to produce except for the science of producing it in a form that can be put to work simply. Biogas not only supplies energy from a waste product but also reduces the venting of methane to the atmosphere[32].

Diary farm runoff presents an environmental hazard from poorly managed animal manure. Runoff can pollute local streams and spread disease. Anaerobic digestion of animal manure to biogas protects surface stream from contamination because the process destroys harmful microorganisms that are carried in manure. Although it is expensive to construct a manure digester, there is also a cost for alternative manure management and cleanup measures that produce no income for the diary operator[30]. Therefore, the effects of environmental degradation caused by fossil fuels outweigh the cost of biofuel production.

CONCLUSION

According to an article by the Union of Concerned Scientists 2010 titled 'the Hidden Cost of Fossil Fuels', many of the environmental problems our country faces today result from our fossil fuel dependence. These impacts include global warming, air quality deterioration, oil spills resulted into human health problems, national insecurity and climate change. Among the gases emitted when fossil fuels are burned, one of the most significant is carbon dioxide, a gas that traps heat in the earth's atmosphere. Burning of fossil fuels has resulted in more than 25% increase in the amount of carbon dioxide in our atmosphere. Fossil fuels are also responsible for increased levels of atmospheric nitrous oxide, sulphur oxide, carbon monoxide and hydrocarbons. Clean air is essential to life and good health. Climate scientists also predict that if carbon dioxide levels continue to increase, the planet will become warmer in the next century. Already warmer atmospheric condition has aided the spread of disease such as typhoid fever, meningitis etc in recent times.

Oil spillage leaves waterways and their surrounding shores uninhabitable for sometime. Such spills often result in the loss of plants and animal life. Coal mining also contributes to water pollution in nearby rivers and streams. The use or dependence on biofuels to meets our energy needs will help to reduce these menace posed by fossil fuels. Biofuel are renewable meaning their sources can be re-grown. Biofuels offers environmental benefits such as lower carbon emissions, lower sulphur compounds than those from conventional petroleum based fuel. The carbon dioxide produced in the burning of biofuel does not contribute to global warming as it is the same as that utilized during the growth process of the plant during photosynthesis. Biofuels therefore could offer solutions to global problems amidst poverty reduction, high energy cost and increased energy security.

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