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A Study of the Energy Statistics Trend and Sustainable Development in Africa

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Abstract

A review study of the energy statistics trends in Africa and Sustainable development was conducted. In this study, overall, Africa is a major energy exporter to the developed world with exception of East Africa exporting substantial amount of energy. North Africa is the largest exporter. In West Africa Nigeria is the only exporter and almost exclusively oil. Despite Africa abundance energy resources, she accounts for only 3% of the total world energy consumption; this is due to her low level of industrialization, low per capita income and poor acquisition and usage of automobiles. These factors compels Africans to resort of traditional energy (such as fuel wood, charcoal, animal waste and so on) consumption without recourse to the environmental effects. Electric power in Africa has only about 94 Gigawatt which is about 3% of the world total electric power consumption and mostly thermally derived. However, Africa energy consumption is been on a gradual increase from 1970 to date on a percentage increase of 2.7% per annum. Sequel to this low energy development, sub regional bodies like ECOWAS, SADC, and EAC are initiating policies to improve and harness the energy resources of Africa towards sustainable development.

Applications and Maintenance of Solar Electricity

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Abstract

A general review of the application and maintenance of solar electricity was carried out in this paper. The burning of fossil fuels to provide electricity is a very tasking business and has been the major cause of global climatic change and because of its non-renewable nature will one day run out. Solar energy is about one solution that can help to alleviate the problems, as it is a completely renewable form of clean energy, the most powerful and also the source of other energies on planet earth. Without the solar energy, none of those fossil fuels that power our society would exist for they are derived from the organic decomposition of ancient algae; plants, plankton, and animal. Solar energy can be used to produce heat, hot water, electricity, and even cooling. The success of any solar electric system depends on how well it is designed, installed, managed and maintained. Some applications of solar electricity include solar street light, solar pumping machines, solar lighting, cooking, solar vehicles and so on. Maintenance is a factor to keep solar electricity in good working order. This work enumerated the necessary tools required in carrying out maintenance activities. A brief trouble shooting guide necessary for effective maintenance is reviewed. This work will form an installation and maintenance manual for individuals, corporate bodies and establishment interested in solar electrification.

Keywords: Application, maintenance, solar, electricity, review, fossil fuel.

Development of Solar Plants For Bulk Power Generation in Nigeria

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Abstract

The recent de-regulation of the Power Utility industry in Nigeria has led to the licensing of Independent Power Producers (IPPs) to attract investment into the sector. The eleven Distribution Network Operator (DNO) Companies are to purchase Electricity as a commodity from the IPPs and Distributed (Embedded) Generation Systems where available. Recent Global Energy Issues are de-emphasizing conventional methods of Power generation to reduce Global warming, now seen as the earth's greatest enemy. A feasibility study of a 10MW solar-pv bulk power energy supply system is presented. Such a system keys into the Global trend to reduce the burning of fossil fuels for bulk power generation. The study brings to the fore the equipment, technical and real estate requirements for such clean energy plants for Distributed Power Generation in Nigeria.



Climate Change the Bane of Hydro-Renewable Energy – Need for Alternative Energy Source

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Abstract

The Niger River basin houses three main hydro-power stations of Nigeria, which are used both for power generation and irrigation. These are Kainji (capacity, 760MW (1968)), Jebba (capacity, 570MW (1984)) and Shiroro (capacity, 600MW (1990)). Presently, Niger Basin constitutes one of the most threatened river ecosystems in Africa. The environmental degradation of the basin results from the combination of anthropogenic and natural factors contributing to the reduction of water resources in the basin as a result of the changing climate. It is against this backdrop that the study attempts to examine the effects of multi-annual fluctuations of rainfall, and their hydrological and ecological consequences on the basin, as well as determine the design or dependable basin's yield that corresponds to the dependable rainfall and to examine the impacts of climate variability/change on availability of dependable rainfall of the basin at 90% dependability that are relevant for hydro-power reservoir operations using Artificial Neural Networks(ANNs). Results show that through the indices of Rainfall Stability (RSS) and Instability of Hydrological Regime (IHR) in relation to the year to year fluctuations that the lowest value of rainfall stability was recorded over Upper Benue sub-basin followed by upper Niger and lower Niger sub-basins; while the lowest instability of hydrological regime was recorded over the Niger South sub-basin. The model simulation result gave correlation coefficient of 0.9956 and RMSE of 24.3. By using hypothetical scenarios along with the forecast model, if the dependable rainfall increases or decreases by 20%, while temperature increases by 2oC over the region in future under the changing climate, it is observed that the 90% dependable rainfall will increase or



decrease by 1590.92mm and 1060.62mm giving yields of 23149311.32M.m³ and 15431342.71M.m³ respectively. If the dependable rainfall increases, it will be good news for the country, but contrary to this, a small shift of climate towards aridity may substantially reduce the amount of energy production and supply, since about 80% of the total electricity consumption in the country comes from hydropower. Further analysis shows that Nigeria has veritable climate resource and potentials whose other indicators line wind speed and direction when properly harnessed could be vital tool in the development of both horizontal and vertical axis wind turbines that could serve as alternative energy source for the nation.

Innovative Micro-Financing of Renewable Energy: The Challenge of Solar Energy Systems in Nigeria

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Abstract

Solar energy is gaining acceptance as an alternative source of energy, and steadily overcoming cultural acceptability. Micro-Financial services are short-term. While it is easy to micro-finance solar systems ranging from 50 to 2000 watts: what types of Micro-Financing are suitable for solar installations from 2000 to 8000 or more watts. Many Nigerian families, particularly the very poor and small entrepreneurs and workshop owners find it hard to invest any capital for household or workplace solar systems. Solar energy solution acceptance is not only limited to the developed economies, where traditional sources of energy are efficient, but also gaining rapid grounds in the developing economies, particularly in the Asian and South American countries, where Micro-Financing of renewable energies, especially the solar energy solution has existed for several years, to

combat greenhouse effects and to power domestic electricity needs. It is sufficiently known that two main reasons stand shoulder to shoulder in the choice of photovoltaic applications as a renewable source of energy. Combating greenhouse gas emissions and provision of domestic electricity loads are all targets of the solar energy systems. Current solar energy concerns, such as the high costs of design, startup capital and installations, call for the attention of the government and the financial institutions to improve on the private sector Micro-Finance, with assistance of the World Bank, to grant loans, credits and grants for solar power projects, targeting the rural and urban poor, at least, to cover up to 75-80% of the total photovoltaic installations. Such Micro Financing arrangement for the low-income is shooting two birds with a single stone – combating global warming and providing electricity for the down trodden is urgent and important for Nigeria to reduce poverty and achieve clean and green environment - pursuant to the targets of the Millennium Development Goals. Universities and solar energy providers should gear-up to establishing intervention measures by setting goals and targets for solar energy technological development in Nigeria, targeting such technical aspects like, System Reliability, Installation, Engineering, Component manufacture and Maintenance. The goals of this article were (1) to assess the current government's policies (federal and state), in promoting solar energy as an alternative source of energy and limiting carbon dioxide and other greenhouse gas emissions (2) to assess the workability and opportunities that are available in the Special Micro-Financing of private solar installations (3) to suggest three cross-optional focal areas of developing solar engineering and technologies in Nigeria.

Developing Local Manufacturing Capacity for SHP Equipment: NASENI Experience

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Abstract

Electricity generation through Small Hydropower (SHP) has been a very good and clean source of power supply all over the world especially for communities that are far from the national grid. Nigeria is blessed with abundant water resources in every Local Government Area (LGA) which could be used to generate the much needed power. National Agency for Science and Engineering Infrastructure (NASENI) has a mission of making electricity generation through SHP viable in Nigeria through the local manufacture of SHP equipment. The Agency has designed and is currently constructing a 10KW capacity cross-flow turbine. The turbine rated power is calculated from the head (H) and discharge (Q) for the selected site; since turbine design and manufacture is site-specific. Ketti, a site in the Federal Capital Territory (FCT) Abuja, has been selected for the pilot project through NASENI's collaboration with UNIDO Regional Center for Small Hydropower in Africa (UNIDO-RC-SHP) in Abuja. Also in the series of collaboration with UNIDO-RC-SHP, NASENI has been selected as the Federal Government of Nigeria's representative in developing local manufacturing capacity for SHP equipment in West Africa. This is expected to jump-start the local manufacturing of SHP equipment in the West African sub-region.



Sustainability of Low Cost Electricity Production through Development and Application of New Materials for Solar Energy Production

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Abstract

Attempt has been made to review successful studies carried out to develop new materials for producing electricity from Sun's heat energy. Results of the various investigations show that electricity could be produced, enhanced and sustained at reduced cost through application of newly developed materials such as carbon nanotube, semicrystalline polymers known as poly3-hexylthiophene or P3HT and nanoparticles (CdS, CdTe, InP, GaAs, PbS, and PbSe) produced by non hydrolytic colloidal synthetic methods, for solar cell design. These cells are adapted for direct conversion of solar radiation to electricity as a result of the extra ordinary electrical properties possessed by the cell design materials. Enhanced efficiency of solar electricity production (through utilization of solar cells made with these materials) is guaranteed when these materials are combined.

The Future of Renewable Energy Growth in Nigeria

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Abstract

Clearly, research shows that the world faces substantial increase in energy consumption, particularly in those disadvantaged areas where population growth

is still high but individual expectations for improvement are also understandably high. The production of energy brings with it the inevitable consequence of environmental disturbance. Whether we consider the denudation of forest to supply wood for the people of the developing world, or the atmospheric pollution that accompanies the generation of electricity in coal-burning power plants, environmental problems grow as energy requirements rise. The purpose of this paper therefore is to examine the availability of renewable sources in the future in Nigeria.

The Application of Marine Technology to Develop Ocean Thermal Energy Conversion (OTEC) – A Renewable Energy Source for Nigeria

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Abstract

In Nigeria, the primary source of energy supply includes the conventional power plants and the hydro-electric power stations. The former utilize non-replenishable fossil fuel while the latter utilize the potential energy of water. Unfortunately, over a period of time, dams silt up. Other forms of water power include energy from the waves, the tides or ocean currents, and the Ocean Thermal Energy Conversion (OTEC). As a source of renewable energy, the OTEC system uses large floating power plants, the temperature difference between warm upper layers and cool lower layers of water can generate electricity. Pilot plants off Hawaii, U.S.A have shown the way. This paper reviews the present state of the art of OTEC, projections of energy sources and consumption in Nigeria for the future. Considerations of the Marine Technology systems, benefits and costs, adaptation of OTEC to the Nigerian context would be discussed.

The Increasing Carbon (IV) Oxide Emissions from Fossil-Based Energy: Possible Reduction by a Simple Mechanism (I)

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Abstract

The amount of Carbon (IV) Oxide, CO₂, gas released into the atmosphere has been on the increase with increasing industrial and human activities. This has resulted in the intensification of atmospheric greenhouse effect and the depletion of the stratospheric ozone layer that shields the earth from harmful ultraviolet radiation. Reducing green house warming has remained an illusion as countries have not been able to implement fully regulations that call for reduction in the emission of CO₂ especially into the atmosphere. We propose a system in which CO₂ is released into a chamber of an alkaline solution. The gas (in this chamber) is converted into a salt of more economical importance with no adverse environmental consequence. The suggested mechanism can easily be incorporated in the machinery of automobiles and also in factories where CO₂ is emitted freely into the atmosphere.

Keywords: Carbon (IV) Oxide, Global Warming, Atmosphere.

Power Generation with Hydroxy Gas-Fuelled Systems

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Abstract

This paper proposes the utilization of an alternative source of energy for power generation which is environmentally friendly with the “Zero Emission” goal. Water, which is abundant in nature and relatively inexpensive, is used as a replacement for fossil fuels in internal combustion engines for power generation. The process involves decomposition of water into a gas called ‘Hydroxy gas’ via the process of electrolysis which is then fed into the engine system for combustion. The output voltage produced by the generator is re-invested into the system to continue the decomposition process. The results show higher efficiency in fuel utilization, higher energy output, less noise, lower engine temperatures and most importantly, waste products of only oxygen and water vapour. Seeing this as a solution to current energy problems, modifications of this technology were recommended for automobile applications.

Keywords: Brown’s gas, Electrolysis, Fossil fuel, Hybrid system, Hydroxy gas, Zero Emission

Distributed Power Generation: A Way Forward to Nigeria Electric Power System

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Abstract

The present population and energy demand in Nigeria presents many challenges to Nigeria Power Supply Industries. The need to satisfy people's energy demands whilst conserving resources, the environment and maintaining a viable economy gives a vivid impression of the dilemmas faced in piloting a sustainable future. Hence distributed generation (DG) is a good option for Power Supply to Niger Delta area. Distributed generation (DG) is a method of Power System operation where small scale power generation is close to end-user or the deployment of small, modular generator units dispersed throughout the customer population. Waste products of our industrialized society can be used to provide energy for our electric power. It has been estimated that 50-60% of urban waste is combustible. Science has proved that potential exists for burning some millions tons of waste products each year, and using the heat to produce steam for driving small steam turbines in order to produce electric power. One of the most prominent organic waste from our local industries in Niger Delta areas is the palm kernel and fibre wastes. For a long time, this has been a source of energy for cooking in our rural communities. However, the amount of heat derivable from the burning of palm kernel waste is appreciable; hence there is the need for such wastes to be used as fuel for boilers in steam turbines plants. In this paper a Biomass Power Plant as an energy source is used to illustrate distributed power generation that can feed the rural communities in Nigeria. The area of this study is mainly the Ohaji-Egbema Palm producing area in Imo State of Nigeria.

Key words: Distributed generation, Biomass, Waste disposal, Palm-produce.

Biomass Potentials: A Sustainable Energy Outlook For Africa

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Abstract

Problems of fuel scarcity and global warming due to air pollution have led to greater demand for renewable and cleaner sources of energy. This paper discusses available alternatives and concludes that the introduction and use of Miscanthus is presently the best option. Recommendations are given on the way forward.

Production of Biosolids from Faecal Sludge in Port Harcourt, Nigeria Using Drying Beds and Assessment of The Suitability of the Biosolids in Maize Production

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Abstract

The potentials of cycling septage sludge for quality farming was investigated. Three concrete unplanted drying beds were constructed at the Rivers State University of Science and Technology, Research Farm. A total volume of 22.8m³ of stable faecal sludge loaded into two drying beds produced a total of 7.6m³ of biosolids weighing 354.7kg. This volume of biosolids represents 33.3% of the faecal sludge volume. The dewatering and drying lasted for an average period of

5.3 days. Another 22.3m³ of unstable faecal sludge which had had only six months of retention in the pit was loaded into the same two drying beds. This volume of unstable sludge produced 5.0m³ of biosolids weighing 234.0kg. This volume of the biosolids produced from this unstable faecal sludge represents 22.42% of the faecal sludge volume. The loading and drying process was repeated three times for both the stable and unstable sludge. The effective average drying period was 7.7 days. A physicochemical analysis of the biosolids revealed that they were rich in the essential nutrient for plant growth particularly nitrogen, phosphorous and potassium. The biosolids were land applied in the cultivation of maize (*Zea mays*) and its performance compared with control treatments with no fertilizers applied as well as treatments with inorganic fertilizer application. The growth and yield of the crops were compared. The yield of the maize was improved by more than 200% over the control without fertilizer through the application of biosolids. Biosolids also compared favourably with commercial fertilizer. The drained liquid (wastewater) was analysed to assess its suitability for surface irrigation. The chemical constituent of the wastewater was dominated by sulfate, chloride, calcium and magnesium.

Tidal Electric Power Generation In The Bonny River Tidal Waters Of The Niger Delta

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Abstract

The dynamics of tidal water inlets within the estuaries of the Niger Delta with particular emphasis on the Bonny River have been studied and used for the purposes of the generation of electrical power. Hydrographic observations involving establishment of tidal poles, bathymetric and current meter observations, including channel geometry determination were carried out on the Bonny River estuary and the information used to design optimum pump sizes, storage reservoirs and other components of the tidal power generating system. A system capable of generating a total of 1.2MW of electricity power, which can satisfy the power requirements of 2,500 family units at 400 watts per family, has been designed. A pump capacity of 150.336m³ per minute, lower and upper reservoirs having a capacity of 3672m³ per day each and an elevated upper and tail race reservoirs of 8 metres and 4 metres high, respectively, was computed as to meet the electricity needs of isolated rural population of the Niger Delta. A comparative cost analysis with other conventional electricity generating systems put this system as most expensive in terms of installation cost but compares favourably in the long run as the system requires no fuel.

Palm Oil Biodiesel, a Potential Fuel for Agricultural Products Processing In Rural Farming Communities in Nigeria.

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Abstract

Five fuels, namely, Dura palm oil biodiesel ($B_1 100$), its blend with diesel, ($B_1 10$), Tenera palm oil biodiesel ($B_2 100$), its blend with diesel ($B_2 10$), and diesel as reference fuel, were used for performance evaluation test at $\frac{1}{4}$ load under a constant speed of 1100rpm. A techno single cylinder water cooled four-stroke diesel engine was used for the test. The blends $B_1 10$ and $B_2 10$ were at 10/90 vol/vol biodiesel/biodiesel. The low speed was chosen for the test so as to predict the performance of biodiesel and its blends with diesel in low-rated speed diesel engines used as prime movers for running Agricultural processing machines in rural villages in Nigeria. Most of these engines are rated at 850rpm. With the fuels, the peak mechanical efficiencies of the engine were 87.31%, 71.66%, 62.58%, 60.08% and 57.91% for Dura biodiesel ($B_1 100$), Dura biodiesel blend ($B_1 10$), Tenera biodiesel ($B_2 100$), Diesel and Tenera biodiesel blend ($B_2 10$), respectively. Also, the Peak torque loads were 29.90 N-m, 27.41 N-m, 26.16 N-m, 26.16 N-m and 29.90 N-m, for Dura biodiesel, Dura biodiesel blend, Tenera biodiesel, Diesel and Tenera biodiesel blend, respectively. Thirdly, brake specific fuel consumption at Peak torque loads were 0.354 kg/kW-h, 0.288 kg/kW-h, 0.348 kg/kW-h, 0.385 kg/kW-h and 0.289 kg/kW-h, for Dura biodiesel, Dura biodiesel blend, Tenera biodiesel, Diesel and Tenera biodiesel blend, respectively. Therefore palm oil biodiesel, especially Dura and its blends were found to be very good fuel for low rated speed engines.

Keywords: Dura palm oil biodiesel, Tenera palm oil biodiesel, Biodiesel blend, Mechanical efficiency, Torque, brake specific fuel consumption

Comparative Study of Biogas Production from Pre-treated Powdered and Un-powdered Rice Husks

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Abstract

Biogas production was carried out using fresh powdered and un-powdered rice husks (P-RH and U-RH, respectively) that were left to degrade aerobically for 73 days. The pre-decayed wastes were found to be acidic. Consequently, a concentrated solution of potassium hydroxide (KOH, 50%w/v) in acetic acid (CH_3COOH , 99% v/v) for stabilization was used to treat the wastes. The pre-decayed, chemically treated rice husks were later charged separately as: Powdered rice husk (P-RH), Un-powdered rice husk (U-RH) and Combined rice husks (C-RH) into metal prototype biodigesters of 50L capacity in the ratio of 2:1 water to waste. Results of volume of gas yield from the different digesters indicated highest cumulative gas yield from the C-RH system of 168.3L/Total mass of slurry (TMS), followed by the U-RH system with a cumulative gas yield of 146.3 L/TMS. The different digester systems sparked at different times. The C-RH system became ignited after 3 days of the digestion period while U-RH and P-RH systems produced flammable gas after 4 and 5 days, respectively. The overall result indicated that combining the two types of rice husk gives the best results in terms of onset of gas flammability and cumulative gas yield.

Keywords: Powdered rice husk, unpowdered rice husk, biogas production, flammable biogas, cumulative gas yield.



Comparative Study of the Effect of Chemical Treatments on Cassava (*Manihot utilissima*) Peels for Biogas Production

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Abstract

A comparative study of biogas production from cassava peels treated with different chemicals namely, potassium hydroxide (KOH, 50% w/v) and locally available salt petre (potash or "akanwu" 50% w/v) was investigated. The untreated peels formed the control. The fresh cassava peels were degraded aerobically for 4 months before the chemical treatment, stabilization and charging took place. The different variants from the treated peels were charged in 50L metal prototype biodigesters in the ratio of 2:1- water to waste. They were charged as; cassava peels treated with KOH (CP-K), salt petre (CP-P) and untreated cassava peels (CP-U). Results obtained showed that while the untreated cassava peels had cumulative gas yield of 59.7L/Total mass of slurry (TMS), the peels treated with salt petre had highest flammable cumulative gas yield of 124.1 L/TMS, whereas cassava peels treated with KOH had (111.3 L/TMS). The lag period before commencement of flammable gas production for Cp-U system was 58 days while that of Cp-P and CP-K were 7 days and 10 days, respectively. The general results showed that biogas yield from cassava peels can be enhanced by chemical treatment. Results further indicated that locally available salt petre (potash) is a better chemical treatment to be employed in the biogas production of cassava peels.

Keywords: cassava peels, biogas production, cumulative gas yield, onset of gas, flammability, lag period

A Self-Regulating System for Microalgal Mass Culture for Energy Generation

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Abstract

The freshwater green alga, *Chlorella vulgaris* 211/8k, has been grown photoheterotrophically on acetate. Supplying the *Chlorella* with nitrogen at an acetate- carbon: ammonium-nitrogen ratio equivalent to the Redfield ratio produced the best growth response. Following from batch results, a system for a self-regulating continuous culture was developed in which medium input was adjusted automatically in response to acetate utilisation. The optimal cultivation temperature and air supply rate were 35°C and 1 vol/vol/min respectively. The highest biomass yield (calculated on acetate carbon utilized) consistent with high biomass production was 42%. The system described requires minimum attention once in operation, adjusting itself according to changes in operating conditions. It is therefore a means of biomass production for energy generation and can be coupled to acetate waste management system.

Biotreatment of Organic Waste Materials: An Effective Recycling Technology for Biogas Production

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Abstract

Biogas technology provides an alternate source of energy in countries with little or no crude oil and other natural resources used as fuel. This technology is hailed as appropriate technology that meets the basic need for cooking fuel in

countries whose populace awaits solution to their growing fuel crisis. Biogas is produced from local resources such as cattle waste and organic wastes (substrate) by the action of various strains and consortia of anaerobic bacteria which act on them at favourable pH values. An attempt was made in this review on previous studies to evaluate the factors affecting biogas production.

Biogas Production from Kitchen Waste (A Crushed Mixture of Yam Peels, Ripe-Plantain Peels, and Beans Coats)

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Abstract

This work was carried out in order to evaluate the yield of biogas in a sample of kitchen waste under normal ambient temperatures and prevailing atmospheric pressure. 20kg of kitchen waste comprising 60% of yam peels, 25% of ripe plantain peels and 15% of beans coats were crushed, mixed with 20litres of water, and digested using a 50litre batch anaerobic digester. Average temperatures ranged from 25°C to 36°C. The substrate was retained for 23 days. Other parameters monitored included Total solids, pH, and Total Viable count (TVC). Biogas production started on the 8th day, and peaked on the 13th and 16th day with a yield of 9.62dm³. The total volume of gas produced after the 23 days retention time was 93.66dm³. The average biogas yield per day was 4.07dm³. A mean temperature of 31.35°C was recorded for the duration of the experiment. This work shows that kitchen waste which otherwise may have contributed to the hazards in our environment could be converted into an environmentally friendly source of energy.

Keywords: Biogas, kitchen waste, anaerobic digestion, anaerobic digester.

The Use of Rapeseed Methyl Ester Biodiesel in Diesel Engines

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Abstract

Biodiesel fuel is made from vegetable oil and can be used in existing Diesel engines without requiring any modifications. The product is produced by transesterification of vegetable oil which uses alcohol (methanol or ethanol) and is known as methylester or ethylester. Since there is an increasing legislative pressure world-wide to use environmentally friendly fuels and a need to find new renewable energy alternatives to fossil fuels, there is a growing interest in biodiesel types of fuel. There is also a necessity to create new applications for agricultural products. Biodiesel fuel is more environmentally friendly because it is biodegradable but it also produces less harmful emissions when used in engines. The fuel does not contain sulphur and hence does not produce any sulphurous oxides which are, to a large extent, responsible for acid rain. The fuel does emit CO_2 but since this is absorbed by the plants during growth, it offers a net reduction in overall greenhouse gases relative to fossil fuels. The test results on biodiesel fuels showed high friction power with a net reduction in hydrocarbon emissions. The carbon deposits on the injector were similar to those observed when running on diesel fuel. The maximum power output was slightly lower than when running on diesel fuel due to low heating value of Plant fuels.

Keywords: Brake Specific Fuel Consumption, b.s.f.c, brake thermal efficiency, Mechanical efficiency, hydrocarbon emissions and Air Fuel (A/F) ratio.

Prospects of Biogas – Fired Electric Power Plant for Remote Area Electrification in Nigeria

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Abstract

The need to improve on the electric energy supply of Nigeria without releasing harmful gases to the atmosphere must be given utmost attention if vision 2020 is to be achieved. This paper presents the availability of the resources, technology, and socio – economic benefits of deploying Biogas-fired electric power plant for remote area electrification in Nigeria.

Keywords: Biogas, Biomass, Gasification, power generation, waste, anaerobic digestion.

Biogas Production for Cooking and Electricity Generation

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Abstract

The ever increasing global awareness and concern about the environmental impacts of fossil fuels together with the price hikes, have lent enormous weight to a switch to renewable energy sources. This presentation is the experimental research work on biogas (renewable), for cooking and of electricity generation. The biogas system comprises of a Biodigester (family) (2m^3), Gasoline generator

(1.5KW), valves, pressure pipes, and a biogas cooker. The biodigester was made from a first grade tarpaulin material. The tarpaulin was cut to the design specifications, sealed with an industrial sealing machine, putting into full consideration all necessary conditions. The plant was loaded with 50kg of poultry waste mixed with enough warm water. The ratio was around 30% solid to 70% Water. The temperature was maintained between 27°C and 35°C daily. Agitation was achieved during the feeding of the in-put into the plant. After four weeks, a test was carried out for a flammable gas (methane), with the use of a bursen burner and the result was positive. The plant produced 1m³ of biogas (Methane-65% + Carbon dioxide-34% + Hydrogen Surphide-*traces* + c.t.c.) daily. The gas was disulphurized and was used to run the converted 1.5KW gasoline generator in a test for about fifty minutes.

Design and Construction of Briquetting Machine for Fuel Production Using Agricultural Waste

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Abstract

The estimated amount of agricultural waste in Nigeria is amounting to tens of millions of dry tones every year, some of this waste is used as animal fodder, organic fertilizer and some part as fuel in primitive stoves, with very poor energy efficiency which may cause health problems and damage to the environment. The rest is burnt in the farm fields causing air pollution problems. This huge amount of waste can be utilized to meet a variety of energy needs, including generating electricity, cooking and providing process heat for industrial facilities among others. This paper will provide a design and construction of briquetting machine that produces briquettes which would be used for direct combustion in

cooking, electricity generation and other energy needs. The technology is simple and as such can be transferred to rural areas for local fabricators to carry on, so as to make it affordable, divert the attention of our populace from deforestation and create job opportunity to local fabricators and farmers for producing briquettes.

Empirical Study on Optimizing Energy Recovery from Oil Palm Waste in Nigeria

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Abstract

Nigeria is endowed with abundant supplies of non-renewable energy resources especially oil and gas and they are currently over-exploited. There is an urgent need to optimize the use of huge quantity of oil palm biomass waste as an alternative energy source. Against this background this article aims to empirically and quantitatively analyze the potential of recovering renewable energy from oil palm wastes. In this study, ultimate and proximate analyses were carried out on oil palm wastes, e.g. Empty fruit bunch (EFB), Palm Oil Mill Effluent (POME), fibre and shell, to determine the level of fixed carbon, crude fibre, ether extract, percentage hydrogen and heat content. The results obtained showed that EFB had the least percentage dry matter (DM) and ether extract of 72.6 and 2.2 respectively, while fibre had the highest % DM of 132.6 and ether extract of 2.87. POME recorded the least heat content of 18229 KJ Kg⁻¹ while the highest of 35631 KJ Kg⁻¹ came from shell. Also there was above average molar ratio of hydrogen to carbon from all the waste categories. From the result, oil palm waste could be an alternative source of biomass energy and can substantially contribute to sustainable resource management system.

Keywords: Oil palm waste, renewable energy, dry matter, heat content.

Kinetics of Biogas Potential from Animal and Domestic Waste

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Abstract

This paper focuses on the following options from the view point of the Kyoto protocol energy use from cow and poultry droppings as well as domestic waste. Biogas potential was determined using laboratory-scale digesters operated to study the effect of varied conditions of pH, and temperature. Gas volumetric technique was employed for the kinetic study. Significant influence of pH on the amount of biogas generated from each system was observed. Gas yield from all systems was maximal in the pH range 6 – 8 (neutral/near neutral) and minimal at acidic (pH 5) and alkaline (pH 9) environments. Temperature influenced several output parameters in the biogas production process. Anaerobic digestion reaction was observed to have followed a first order kinetics as closely related values were obtained from the rate constant. The trend of activation energy (E_a) (Cow dung > Poultry > Domestic) corroborates the incubation period observed in cow dung and poultry dropping before gas production. The activation enthalpies vary in the same manner as activation energies; the enthalpies of activation were higher in cow dung and poultry droppings than in domestic waste. The necessity of reduction in CO_2 emissions resulting from substitution of fossil fuel, and reduction of other greenhouse gas emissions through appropriate treatment of these waste materials will be highlighted. The feasibility of biogas for exploitation in homes and farm settlements in order to promote biogas utilization is also discussed.

Keywords; Animal and domestic waste, biogas potential, greenhouse gas emission, pH, temperature.

Optimization of Catalyst Regimes for Biodiesel Production Using Waste Vegetable Oils

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Abstract

Biodiesel was produced by the transesterification process using methanol as the alcohol. Four acid systems, namely phosphoric, sulphuric, hydrochloric and boric acids were used as catalysts. The acid concentration ranged from 0.5 to 2%. Other factors studied included volume ratio of methanol to waste oil, contact time and temperature of reaction. The results were subjected to analysis of variance (ANOVA). Such analysis showed that factor interaction was absent at less than 0.05 probability level. ANOVA also revealed that at 5% level of confidence there was no significant difference between the acids tested. This result was at variance with optimal yields of 0.5%, 1.0% and 1.5% for phosphoric, hydrochloric and boric and sulphuric acids respectively.

Keywords: Biodiesel, Acid Catalysis, Transesterification, Methanol, Waste Vegetable Oil.

Relationship between the Activation Energies of D-(+)-Sucrose Fermentation and Those of Its Inversion Products.

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Abstract

The relationship between the activation energies of the fermentation of D-(+)-sucrose and those of its inversion products has been studied using the kinetics of carbon dioxide evolution during their fermentation processes. The activation energies of D-(+)-sucrose, D-(+)-glucose and D-(-)-fructose were found to be 0.130 kJmol^{-1} , 0.073 kJmol^{-1} , and 0.062 kJmol^{-1} respectively. The sum of the activation energies of D-(+)-glucose and D-(-)-fructose ($0.073 \text{ kJmol}^{-1} + 0.062 \text{ kJmol}^{-1} = 0.135 \text{ kJmol}^{-1}$) was found to be very close to the activation energy of the fermentation of D-(+)-sucrose (0.130 kJmol^{-1}). These results suggest that the activation energy of the fermentation of D-(+)-sucrose is the sum of activation energies of its inversion products.

Keywords: Sucrose, Glucose, Fructose, Activation Energy, Fermentation

Glucose from Plant Extracts

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Abstract

Glucose was produced from aqueous extracts of three indigenous plants namely; *Gultiferae* (*Garcinia kola*; aku ilu (Igbo)) *Ocimum gratissimum* (scent leaf; nju anwu (Igbo)) and *Aloe vera*. In each case, the extract was treated with dilute

hydrochloric acid and partitioned with chloroform. The aqueous layer was neutralized, filtered and acidified. The sugars present were analyzed using paper chromatography and estimated as the osazone. The results showed a quantitative presence (w/w) of glucose in the extracts. It was concluded that glucose, a monosaccharide sugar and precursor of ethanol (a bio-fuel of great importance), could be produced from the aqueous extracts of virtually all green plants.

Keywords: Plant Extracts, Glucose, Ethanol, Bio-fuel

Determination of Polysaccharides in Fibres of the Nigerian Oil and Raphia Palm Trunks as Feedstock for Bio Ethanol Production

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Abstract

Oil palm trunk (OPT) and Raphia palm trunk (RPT) were investigated as potential sources of bioethanol. The trunks were obtained from old spent trees, chopped, dried, ground and then sieved to yield five fractions of particle sizes (mesh sizes) 0.150, 0.212, 0.300, 0.425 and 0.600mm. The five fractions were analyzed for the polymeric sugar content (polysaccharides) and lignin using high pH anion exchange chromatograph with pulse amperometric detection (HPAEC/PAD). The result of the compositional analysis showed that glucan and xylan were the major polysaccharides in both OPT and RPT and a reversal of cellulose content with mesh size. While the highest percentage of glucan 62.5% was found in the lowest particle size (0.150mm) in RPT; the least 35.1% was found in the same 0.150mm of OPT. The total carbohydrates within the five mesh sizes in OPT

ranged from 54.3% to 59.8% while that of RPT was 66.8% to 72.3%. OPT has higher klason lignin and xylan content of 21.6% - 22.3% and 14.6% - 16.7% than RPT 12.2% - 14.9% and 8.3% - 13.9% respectively. From the composition, one dry tonne of RPT ground to the particle of 0.150mm is expected to yield 500 litres of ethanol on complete hydrolysis and fermentation. While about 380 litres is expected from OPT of particle size 0.150mm, the particle size of 0.600mm will yield 400 litres. The six carbon sugar contribute more than the five carbon sugars in both OPT and RPT, therefore RPT will yield more ethanol than OPT theoretically because it has higher glucan percentage

Keywords: Lignocellulose, Polysaccharides, Bioethanol, Raphia palm, Oil palm.

Factor Analysis in Base Catalysed Transesterification of Waste Vegetable Oil for Biodiesel Production

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Abstract

In this work, the effect of catalysed transesterification of waste vegetable oils was examined by analysis of variance methods. Such factors as methanol: triglyceride ratio, contact time and temperature were kept constant at 6:1, 2hrs and 55°C respectively. The bases used as catalyst were sodium and potassium hydroxide, sodium carbonate and sodium silicate. The concentrations of these bases ranged from 0.5% to 2.5% respectively. Efficiency was determined by weight of biodiesel produced per weight of catalyst used. Optimal catalyst concentrations for best diesel yield were different for each base and were found to be between 1.5 and 2%. Analysis of variance (ANOVA) at 5% probability

shows that there is significant difference between the performances of the catalysts. Factor analysis in the ANOVA format indicates interaction between catalyst type and volume ratio of methanol and ethanol..

Keyword: Biodiesel, Waste Vegetable Oil, Methanol

Research Developments on *Jatropha curcas* as an Alternative Energy Source and for Sustainable Environmental Management in Nigeria

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Abstract

Scientists worldwide are making frantic efforts towards the development of renewable and environmentally friendly sources of energy as alternatives to fossil fuel. One of the renewable energy considerations is biodiesel. *Jatropha curcas* is one of the identified prospective biodiesel yielding plants. Although native to Mexico and Central America, *J. curcas* grows extensively in Nigeria from the arid Sahelian to the moist Rainforest zones and produces oil-rich seeds. This paper outlines the uses of *Jatropha curcas* and the scope of its cultivation in Nigeria. It also highlights recent research efforts and achievements on *Jatropha* development, while strategies for sustainable biodiesel production and environmental management in Nigeria through *Jatropha* farming are suggested.

Fabrication And Performance Evaluation Of A Biodigester For Organic Wastes

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Abstract

Optimal design operating and environmental parameters for biodigester have been discussed. A 210.0 liters capacity prototype batch biodigester has been constructed. It is leakage proof, rust resistant, simple in operation and maintenance. It can serve up to 5 decades at low maintenance cost. Poultry droppings simulation of the test system shows that it has an average (STP) specific biogas yield of 307.0cm³/kg day. The biogas yield was collected and measured by downward displacement of water using calibrated gas jars. For storage it was collected by passing the biogas into a deflated motor tire tube reconstructed to have inlet and outlet for biogas, from where it is compressed into a gas cylinder for storage. The biodigester can serve in supplementing a family's domestic heat energy needs. It also yielded results that were used for formulating a model for sizing of a biodigester given the daily volume of biogas need. To bring the biogas to the standard of liquefied natural gas the researchers have suggested passing it through a refining unit whose make up has been discussed. Encouragement of biogas technology use and use of biodigestion byproduct (effluents and solid) in soil enrichment biofertilizer) have been recommended.

Design, Construction, and Performance Evaluation of a Thermosyphon Solar Water Heater

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Abstract

Nigeria's solar energy potentials, need for solar water heating and economics of solar water heaters have been discussed. Optimal design and operating parameters of solar water heaters have been reviewed. The evaluated performance of the system based on mathematical models indicates that it has a maximum average daily collector efficiency of 0.692 and a mean system temperature of up to 78^o C. The collector efficiency drops to an average seasonal value of 0.53, having negligible variation with weather conditions. The system temperature drops with decrease in insolation to an average value of 44^o C at dusk. The system loses almost all its heat gain during hours of no insolation. Possible measures for increasing the system heat retention has been discussed.

Design and Measured Performance of Cylindrical Solar Water Heater

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Abstract

A novel cylindrical solar water heater was designed and fabricated locally. It consists of a cylindrical transparent plastic tube as glazing material, having a length of 0.9m, outer diameter of 0.3m and a thickness of 2mm. A spiral ring of copper tube with inner diameter of 11.40mm and 12.70mm outer diameter, painted black, serves as the incident solar energy collector on the cylindrical tube. It was operated under meteorological condition of Owerri, Nigeria. A maximum temperature of 22.3°C was obtained between the tank inlet and outlet of the solar collector at a design mass flow rate of 0.002kg/s. This reveals that the cylindrical solar water heater has a good capability of converting solar energy to heat, which can be used for heating water. It is simple to fabricate, no tracking requirement, cost effective and adds no operational or maintenance complexity compared to the flat plate.

Biomass Energy: Modern Applications and Alternative Uses

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Abstract

Biomass may have some modern applications in addition to direct combustion. Biomass can be converted into methane or ethanol, which are clean-burning, easily storable, and transportable fuels. These alternative uses of biomass also

allow nutrients to be returned to the soil and help reduce our reliance on expensive energy consuming artificial fertilizers.

The Design of a Solar Heating and Cooling Structure for Preservation of Agricultural Product (Rice) During Sunshine

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Abstract

The solar structure utilized the heating and cooling potentialities of the solar rays to perform the functions of preserving agricultural products (rice) by drying process and provision of comfort cooling for the workers. The device consists of the heating and cooling units, and is made of two compartments. The first of this contains the black-coated solar collector plate which, on exposure to the solar rays, heats the incoming air into the glazed box housing the solar absorber/collector to a temperature of about 80°C, which entering the drying unit, reduces the water content of the rice to 15% suitable for planting. The second compartment of the structure has a roof containing 0.05m³ water pond exposed to the solar rays. By evaporative and radiative cooling processes, the volume under the roof is cooled for the comfort of the workers. This solar structure constructed with local materials provided a cheap means of preserving agricultural products (rice) by drying at minimum cost, and furthermore provides a comfortable working environment for the workers.

Keywords: structure, rice, preservation, solar, drying, cooling.

A Solar Dryer with a Biogas-Heat-Assisted Device for Continuous Drying Process for Agricultural Product (Rice)

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Abstract

The Design and Fabrication of a solar dryer with a biogas-assisted-device for continuous drying process for farm product (rice) is executed. The dryer is made up of two major components, the solar dryer and the biogas production source. The dryer receives heat from the solar rays on exposure of the plant to the sunshine. The heat from the biogas is supplied by the burning of the methane gas produced by the decomposition of cow dung, in a controlled pit, at night when the sun sets. Using an integrated design and construction of the two sources of heat, it was possible to produce a dryer capable of operating any time. Local materials were used in the manufacture of the solar machine, so the maintenance cost is low. The dryer, which has an efficiency of about 60%, is capable of reducing the water content of the stored product (rice) to about 15%. The fabrication cost of plant is about ₦10, 00 and its service life is below five years. The dryer can be adopted for drying other materials.

Review of Solid Adsorption Solar Refrigerator III: An Overview of the Solar Collectors for Refrigeration Applications

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Abstract

A review of the solar collector types used in solar adsorption refrigeration application is presented. They have been classified according to their shapes

and/or mode of holding the adsorbent as: the box type, the flat plate type with tubes bonded on it, adsorbent tube bonded side-by-side, concentrating and evacuated tube collectors. The performances of adsorption refrigerators built using them are also presented. The technical problems associated with these collectors, their performance evaluation theory and their design considerations are discussed.

Keywords: Solar, Collector, Refrigeration, Adsorption, Adsorbate.

Options for the Acquisition of Photovoltaic Solar Energy Technology in Nigeria

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Abstract

Conventional power grids serve consumers within reach of its networks. Unfortunately, that excludes a wide range of consumers. Photovoltaic systems make people independent of the power grid without polluting the environment. As a renewable, clean source of energy, photovoltaic technology can supplement, and in some cases, even replace conventional electricity generating methods. This paper discusses the workings of photovoltaic technology, the aspects involved in the acquisition of solar photovoltaic technology and the technological options available to Nigeria for the acquisition of photovoltaic technology.

A Review of Solar Water Heating Systems

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Abstract

A review of solar water heating systems for domestic and industrial applications is presented. They are grouped into two broad categories as passive and active Solar Water Heating Systems (SIIWS). Each of them operates either in direct or indirect mode. Their performances, uses and applications and the factors considered for their selection are reported. The active systems generally have higher efficiencies; their values being 35 – 80% higher than the passive systems. They are more complex and expensive. Accordingly, they are most suited for industrial applications where the load demand is quite high or in applications where the collector and service water storage tank need not be close to each other or for the applications in which the load require more than one solar collector. On the other hand, the passive systems are less expensive, easier to construct and install. They are most suitable for domestic applications and in applications where load demand is low or medium. Generally more research and development work are needed to further improve on the existing level of efficiency for it to serve effectively as a viable alternative to the conventional means of hot water generation. The actual field testing experiences, together with the prospects and economic problems that affect popularization of the systems are also presented. Their possible solutions are suggested.

Keywords: Solar, Thermosyphon, Hot Water, Integrated Collector Storage, Passive, Active.

Design, Construction and Experimental Investigation of a Natural Circulation Pressure Type (Thermosiphon) Solar Water Heater

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Abstract

The experimental investigation of direct solar water heating system is presented. The system was designed to use a natural pressure circulation or thermosiphon method to achieve solar heated water. The thermosiphon system follows a general passive heating of water. The location of the collector system is north-south direction upon which the sun is allowed to heat the water in the collector through various water tubes that absorb the heat from the plate by conduction and transfers it to the water passing through the tubes by convection. In the process, the water becomes warmer compared to the water in the tank. The parameters measured include water flow rate in m³/hour using industrial grade water flow meter. Five sets of temperature readings: inlet temperature, T_1 ; plate temperature, T_2 ; outlet temperature, T_3 ; lower tank temperature, T_4 and upper tank temperature, T_5 were taken. The results show that the maximum temperatures recorded were 83°C for outlet temperature; 70°C for plate temperature; 35°C for lower tank temperature and 48°C for upper tank temperature. The average water flow rate was 0.3308 m³/h. The system's thermal performance was found to be highly efficient.



Design, Construction and Testing of a Parabolic Solar Cooker

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Abstract

The several use of solar energy includes domestic cooking, heating and production of electricity using solar photovoltaic cell. In this work, we present a parabolic solar cooker constructed locally for domestic cooking purposes. The base is aluminum foil laced with plane mirror to reflect the sun's ray to the focal or cooking point which is 15cm determined using approximate method. The constructed parabolic solar cooker was used to boil water to a temperature of 100°C which took a time of 20 minutes. On the other hand, it was able to boil yam within 60 minutes. The results were better than the ordinary parabolic solar cooker which didn't have a mirror on the aluminum base.

Possibilities for Cost Reduction of Solar Cells Using the Organic Photovoltaic Cell (OPV)

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Abstract

The driving force for the development of new photovoltaic materials is the reduction of the manufacturing costs of the photovoltaic cells and modules. A general discussion of the possibilities for cost reductions and alternative strategies for its pursuit is therefore worthwhile in this connection. Synthetic organic materials such as plastics are used literally everywhere in our daily life. One of the possible future applications of these new organic electronic materials is an organic solar

cell. The potential of organic solar cells is related to the idea of low-cost photovoltaic materials such as polymers (plastics), which could be easily manufactured as large area films, cut from rolls and installed onto permanent structures. Power generation by grid connected PV systems is perhaps the main application today pursued to be realized in the future in a large scale. To reach this goal, the cost of the PV systems and thus the cost of solar electricity need to be reduced significantly. The cost of solar electricity is affected not only by the cost of the whole PV systems measured in ¢/Wp , but also on the irradiation level on the site of the PV installation. The profitable PV module costs are about US \$3.50/Wp at present, and are expected to decrease to US \$2.00 in 2005 and US \$1.50 in 2010. In this progress supporting governmental action has been playing a crucial role, and will do so also in the future until the costs of PV drops closer to the grid electricity price. Although governmental subsidies are essential to help the photovoltaics to enter the market, the way for a significant market penetration will become much easier as soon as the PV electricity turns to truly economic without any major subsidies.

Keywords: Organic solar cell, photovoltaic technology, power generation, and governmental subsidies.

The Nigerian Solar Energy Challenge

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Abstract

Solar energy is the radiant heat and light from the sun that has been utilized by man to alleviate demanding energy needs since the ancient times. With range of available technologies solar energy has found an enviable place in mans quest

for clean, available and affordable energy source to meet her ever increasing energy needs. Regrettably, Nigeria seems to have missed out or failed to tap and utilize the available technology in solar energy to solve her perennial energy problem which has become a national disgrace. This paper examines the viability of using solar energy to alleviate the Nigerian energy needs, its comparative advantage over the dominant energy source today. It also considers different applications of solar energy and explores the practicability of depending solely on solar energy to meet our energy needs.

Review of Solar Cell Materials and Fabrication Technologies

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Abstract

Solar cell is a semiconductor device that converts solar energy to electrical energy by photovoltaic effect. The first solar cell was built in 1883 with conversion efficiency of 1%, however the first practical cell was produced in 1954 at Bell laboratories after it was discovered accidentally that doped silicon is very sensitive to light. The first generation solar cells were fabricated from high quality bulk, single crystal in form of wafer and single junction silicon devices. The second generation solar cells involve thin film semiconductors. The first set of thin film materials employed in the fabrication include cadmium telluride (CdTe), Copper Indium Gallium Selenide (CIGS), amorphous and microcrystalline silicon. Multijunction photovoltaic cells and the use of concentrators have evolved to achieve higher conversion efficiencies. The first generation cells have theoretical efficiencies of about 33%, but with the recent trend of research and materials, 30 - 60% efficient cells have been predicted. Presently, the range of efficiencies that have been achieved are in the 19.9 - 40.7% range, with the multijunction cells having the best performance.

Overview of Nocturnal Cooling Systems

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Abstract

A comprehensive review of nocturnal cooling activities and its application to space cooling across the globe is presented. The utilization of the nighttime cooling concept and the appropriateness of its application in areas requiring space cooling to substantially reduce energy demand in space cooling are discussed. Recent developments and limitations to nocturnal cooling systems are highlighted. The impacts of weather-related influences such as cloudiness, dust cover, dew point temperature and wind speed have been identified as the major factors affecting nocturnal cooling especially in the tropics. Nocturnal cooling has great potentials to substantially reduce space cooling cost to about 30% on the average.

Keywords: Nocturnal, Emissivity, transmittance, Radiative

Solar and Geothermal Energy Sources Development-A Crucial Need For Developing Countries

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Abstract

This paper will give insight into renewable energy sources such as solar energy and geothermal energy that can serve as better alternatives to fossil fuels. The developing countries of the world are worst hit by the soaring prices of fossil fuel

e.g. kerosene, petrol, cooking gas, coal, etc. Interestingly, the technology to harness clean and safe renewable energy sources like the solar, wind, Geothermal, is becoming increasingly efficient and cost effective. In this paper careful analysis of the current environmentally friendly technologies in harnessing these safe and reliable energy sources have been done. This will undeniably aid in formulating energy policies of our great Nigeria.

Solar Electricity Potential and Optimal Angle for Monitoring Solar Panels in The Six Geo Political Zones Of Nigeria

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Abstract

The photovoltaic geographic information system [PVGIS] is a model to aid in solar electricity assessment over Europe and Africa. Presented In this paper is the need of harnessing the optimal optical angle of solar energy using solar panels mounted differently in the six geopolitical zones in Nigeria. The potential optimal angles for monitoring solar panels ranges from $[11^{\circ}-14^{\circ}]$ in the southern zone while $[13^{\circ}-16^{\circ}]$ in the Northern zone. It is an added advantage that PVGIS should be harnessed and improved on to aid renewable energy in the country. The maximum solar irradiation at the optimal angle for inclining the solar panels is as follows Southsouth has a value of 7204wh November at Uyo while Calabar has 2857wh in August. Southwest zone has its value of 6739inAugust at Akure while Ibadan has its value at 3186wh in November. South east has its value 6353wh in January at Awka while in September at Owerri, its value is 3306wh. The Northeastern zone has its value of 7313 in November at Bauchi while in Jalingo 4162wh in August. The North central has its value of 7457wh in November while in august at Minna, it is 3235. The north west has its value of 6893in November at Kaduna while in August at BerinKebbi it is 4168.

Assessment of Solar Electricity Potential in Niger-Delta Region of Nigeria

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Abstract

The photovoltaic Geographic Information System (PVGIS) Has been used to provide potential of solar Electricity in Niger-Delta Region of Nigeria. The sites used are Owerri, Asaba, Awka, Calabar, and Port –Harcourt etc. The range is from 5.1Kwh at Calabar in he month o f January to 1.6Kwh at Port-Harcourt in the month of June. Since the Electric Power from the National grid supply is not sufficient and reliable, we can get alternative from the abundant solar radiation from the Niger-Delta region. These will fast track development in the region thereby checking Youth restiveness especially in a depressed global economy when alternatives to the convectional energy sources need to be encouraged

Climate Change and Renewable Energy for Sustainable Development in Nigeria

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Abstract

The main thrust of the paper is that environmental preservation and management system is the heart of sustainable development in any nation. And that energy is a key component of any poverty eradication and sustainable development strategy and it is critical to the achievement of the MDGs. Climate change presents significant threats to the achievement of the Millennium Development Goals especially those related to eliminating poverty and hunger and promoting environmental sustainability. Renewable and alternative energy are becoming popular in the world due to the fact that aside from being the most favoured alternative for carbon free society, it has the lowest environmental impact of all energy sources. Whilst rich countries are most responsible for climate change, it is the poor countries that are paying the price. Therefore, the rich and the poor countries must assume some responsibilities in tackling climate change. In recognizing the importance of renewable energy for sustainable development, the paper concludes by presenting, in brief, NASENI's intellectual commitment and human capacity development in Solar energy, Small Hydro Power and Wind energy.

Renewable and Alternative Energy Policy: The Imperatives of The Project Model For Nigeria

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Abstract

The need for cheap alternative and renewable energy in the world generally and particularly has been highlighted in this paper. The urgency of the problem and solutions so far attempted in Nigeria have also been acknowledged. It has been shown that the functional management thinking mode as implicated in Nigerian energy policies to date is incapable of timely delivering the desired solutions. The project model and projectization, using the G-O-P framework, that is anchored on private enterprise, has been put forward as a policy imperative in order to move efficiently/effectively achieve the desired objectives.

Keywords: Renewable energy, Alternative energy, Project model, Policy.

Food Versus Fuel: The Way Forward For Africa

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Abstract

The recent crisis in energy particularly from fossil fuel has necessitated the development of other alternatives such as bio-fuel. Unfortunately, the diversion

of resources from food crops to bio-fuel has brought about high grain commodity prices. It is noted that about 14% of the world's total population lack adequate food, and majority of them come from China, India, Africa, and Latin america. Thus the need to pay attention to the production of non cash crops or non edible crops as a source of energy is inevitable. *Jatropha*, for example, has attracted a fair amount of attention in recent years. A hardy bush thought to be appropriate for cultivation in Africa, *Jatropha* thrives in arid areas and can be grown on desert and marginal lands without taking land out of cultivation for food production and without requiring expensive inputs like fertilizers and water. This paper therefore, examines the conflict arising from the use of scarce food crops to promote bio-fuel and its attendant consequence on food scarcity. The paper also recommend some policy measures that would deter farms from producing food crops for energy usage or using fertile lands for such energy crops.

Review of MHD Applications in Nigeria

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Abstract

Magneto-hydrodynamics Research though started five decades ago has a lot to do in Nigeria, as a country which has many thermal Power stations (steam and gas). We have Petroleum and therefore at least for the next hundred years we will be applying heat engines. This work looks at the several efforts some Nigerian researchers have done towards the improvement of the nations Technology via Magneto-Hydrodynamics (MHD). The federal Government is therefore advised to look into the application in our existing Power stations to augment the Electrical Power generated in the Country.

Solar Desalination of Salt Lake Water

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Abstract

The process of solar desalination an innovation technology was introduced for salt extraction in to women salt producers at Uburu and Okposi, Ebonyi State Nigeria. A solar salt desalination system was design and constructed and performance evaluation conducted for the purpose of salt and water production at Uburu and Okposi Ebonyi State Nigeria. The desalination system consists of a distillation chamber with a basin having a capacity of 0.11m³. The performance evaluation of the desalination system using different levels of salt lake solution was under taken at the National Centre for Energy Research and Development, University of Nigeria, Nigeria, latitude 6.8°N, longitude 7.2°E. The characteristics composition of the lake sample solution was carried out before the desalination operation. Result of the evaluation indicated that a daily output of 37.5, 152 and 262 ml of water could be achieved using the lake solution from 2, 4, and 6 litres of the lake water while 66, 120 and 182 grams of salt could be recovered from the same solution in three days respectively. The analyses of the distillate showed that the distillate could only be good for laboratory and other domestic operations rather than drinking because of the mixing of some trace elements. Solar desalination is therefore recommended for salt and water recovery at Uburu community. The utilization of solar desalination in the community will further strengthen the economic activities of the people.

Keywords: solar, desalination, Uburu Lake



Solar Radiation Pattern at Okigwe, Nigeria: The Prospects of Siting Solar Power Systems

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Abstract

The solar radiation pattern at Okigwe, Nigeria located at latitude $5^{\circ}40'N$ and longitude $7^{\circ}0'E$ has been studied by means of a silicon solar cell with an average power conversion efficiency of about 10.23%. Hourly and daily measurements were performed for the period, January to April, which is an important part of the dry season. The measured pattern revealed a generally high insolation reaching up to a monthly mean hourly value of about $1011.85Wm^{-2}$ with a daily time duration of about 12 hours with about 8 hours of noontime sunlight. A slight diurnal variation was recorded during the period. A slight monthly mean variation was also recorded changing from about $10.22Kwm^{-2}$ in January to about $9.99Kwm^{-2}$ in April. This pattern makes the prospects of siting solar power systems in Okigwe strong.

Integrating Coal-Based Fuel Technology into the National Energy Mix: An Old Solution to Nigeria's New Energy Problem

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Abstract

Incessant electric power interruptions and prolonged outages have major problems in Nigeria and constitute an overriding constraint to economic development. With less than 2000MW of electricity generation, the national Energy Development Index (EDI) is estimated at 0.05, providing for a low Human

Development Index (HIRDI) class, compared to EDI values of 0.6 to 0.9 and a high HRDI for developed economies. The problem of poor electricity generation and distribution can be attributed to an inappropriate national energy mix consisting of oil and gas (88%), coal (0%), nuclear (0%), hydropower (7%) and other renewable (5%), indicating a near 100% reliance on oil-gas option which is sourced from geopolitically unstable areas. An analysis of the world energy model including those of the developed and emerging economies of the world show the following energy mix: oil and gas (60%), coal (25%), nuclear (8%), hydro/renewable (7%). This statistic clearly shows that the coal-fired power component absent in the Nigerian model plays a stabilizing role in those of other economies. It is shown from case histories and similitude studies that incorporation of the well understood coal and tar sand-based technology within the clean-coal-technology framework in our energy mix can stabilize Nigeria's energy profile and provide jobs, while also avoiding the environmental affects of greenhouse gas emissions. Furthermore and basing on costs, construction period, available technology as well as factors of safety, it is shown that coal-based alternative energy source has the potential to most quickly bridge the national energy demand-supply gap and provide the needed power relief in the very short and medium term. Nuclear, biogas and other forms of renewable energy would compliment national energy demand in the medium and long term.

Preparation of Zinc Oxide Thin Films Using The Chemical Bath Technique

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Abstract

The thin films of zinc oxide were prepared on glass substrates using suitable reactants. The buffer solution of ammonia – ammonium chloride was used as the pH moderating agent and precipitant. The samples obtained were annealed before characterization. The structure and elemental composition were investigated by x – ray diffraction (XRD) and x – ray photoelectron spectroscopy (XPS). The absorption coefficient and refractive index were obtained from the absorbance data within the ultraviolet (UV) and near infrared (NIR) regions. Using the spectral data in the visible domain, the optical band gap energy of the samples, estimated from the energy dependence of the absorption coefficient near the fundamental absorption edge, were in the range of 3.2 – 3.4eV.

Synthesis and Characterization of Cadmium - Zinc Oxide Thin Films

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Abstract

Cadmium – zinc oxide thin films with varying atomic concentration of reactants were deposited on glass substrates using the chemical bath (CBD) technique. A buffer solution was used in the reaction to ensure gradual precipitation. The structural nature of the annealed samples was investigated by x-ray diffraction (XRD) while the elemental compositional was analyzed with x - ray fluorescence (XRF) that emits the Ag – K x – rays (22.1 keV). The spectral characteristics of the optical constants were analyzed using the transmittance data in the visible region. The optical band gap energy estimated from the absorption spectra gave a direct inter-band value within the range of 3.3 – 3.6 eV.

Key words : chemical bath technique, cadmium – copper oxide thin films buffer solution, x – ray fluorescence, anti-reflection coating, solar cells.

Renewable and Alternative Energy: The Socioeconomic Issues

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Abstract

The Industrial Revolution bequeath to mankind, among other things, the ability to mass produce goods, which was made possible in part by the exploitation of the combustion engine with fossil fuel as the energy of choice. However, it came at a cost: the destruction of the environment. As a result of this, it became pertinent to consider alternative sources of energy which is clean and sustainable. This paper presents the argument for and against renewable and alternative energy from the point of view of their socioeconomic implications. Socioeconomic issues such as the market forces, financing, energy diversification, trade balance, inflation, investments, tariffs, infrastructures, added value, agriculture and employment were highlighted especially in the light of the competition between bioenergy and food security. It was discovered that the development of renewable and alternative energy, though not a new phenomenon, is still in its infancy. However, as technology improves, it is hoped that these sources of energy will contribute substantially to the huge and increasing energy needs of the world in a sustainable way.

Key words: Alternative energy, bioenergy, renewable energy and socioeconomic issues.

Sustainability And Renewable Energy Policy Issues In Nigeria (A Geographical Allocation Approach)

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Abstract

Energy policy issues in Nigeria have become a national priority affair which challenges the capability of our power production technology. The insufficiency of the hydro sources to provide for our daily needs has made power production diversification a necessity. Again in the thermal energy sector, this hydro electric power supply insufficiency has resulted in excessive dumping of sub-optimal generators and allied power sources from the Asian continent into Nigeria. To this end therefore, the evolution and adoption of alternative energy sources that will complement the National Energy supply network of Nigeria (Power Holdings Plc) has become imperative. In this paper, the focus is to suggest an energy policy option that embraces sustainability while adopting a geographical allocation approach that cuts across various industrial sectors for identified renewable energy alternatives.

Overview of Renewable Energy Sources in Nigeria

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Abstract

This paper deals with the situation of renewable energy in Nigeria. Its main purpose is to give an overview of the conditions prevailing in the country, regarding those activities leading to the systematic process of adoption and use of renewable

energy technology, as part of the energy supply mix in the country. In the paper, an attempt is made to focus on the following elements considered crucial in the process of adoption and use of renewable energy technology: policy, institutional framework, technology stocks, financing schemes, and the renewable energy resource base. It is the understanding of the authors that when these elements are properly established and harmonically put in place, the process of technology adoption can be accelerated towards the successful and sustainable internalization of renewable energy in the economy of the country.

Sustainability of Agricultural Production in Jibia Irrigation Project Using Renewable Sources of Energy

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Hamza El-ladan³, and Murtala Mohammed Ruma¹**

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Abstract

Agricultural production in most parts of the semi arid Katsina is supplemented by other sources of water supply especially during the dry seasons. Since the construction of Jibia dam in 1991, only about 170 hectares out of 3,500 hectares have been under irrigation due to inadequate supply of diesel to power the engine for adequate water supply to the farms. This situation has worsened leaving large areas of land uncultivated while the dam stores large volume of water. In this paper, therefore the potential of renewable sources of energy in hybrid form (wind, solar thermal and agricultural waste fuel) will be explored and harnessed to generate power that could subsequently be used to adequately supply water to the vast uncultivated agricultural lands around Jibia irrigation project in Katsina state.

The Need for Energy Efficiency in Nigeria: Taking the Footstep of Niger Republic

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Abstract

Worldwide, nations are beginning to face up to the challenge of sustainable energy by altering the way energy is utilised so that social, environmental and economic aims of sustainable development are supported. Nigeria is a developing nation with significant industries, public buildings, private commercial buildings and households which by its nature depends on intensive use of energy. This energy intensive economy, largely relies on our crude oil reserves for its driving force. At first sight there would appear to be an apparent paradox between using less energy and developing a healthy and prosperous nation based on energy intensive activities. However, in recent years energy efficiency has significantly gained in stature and has become recognised as one of the most cost effective ways of meeting the demands of sustainable development. The benefits of energy efficiency upon the environment are self-evident and the economic benefits of improving energy efficiency have been well documented since the first Oil Crisis in the early 1970's. Many forward-thinking industrial and commercial concerns have already adopted energy efficiency as a key policy towards maximising profits. Niger Republic which relies partly on Nigeria for its energy supply (from electricity) were able to achieve some level of high energy conservation and efficiency. This paper would examine the policies and strategies adopted in Niger Republic and at the end recommend some measures to be adopted in Nigeria since energy efficiency is fast gaining ground as a cost-effective means to approach all aspects of sustainability.

Potential Economic and Social Benefits of Promoting Energy Efficiency Measures in Nigeria.

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Abstract

The paper discusses with lucid examples the potential economic and social benefits of promoting energy efficiency measures at the industrial, institutional and domestic levels in Nigeria. Energy audit and surveys as major tools in energy efficiency measures are pointed out. Because saving energy reduces cost and releases funds for other purposes those traditional no cost-to-low cost house keeping measures that save a great deal of energy but are often neglected due to ignorance are highlighted. Furthermore, attention is also drawn to the negative impacts of greenhouse gas emissions and the feasible benefits of mitigation through energy efficient practices at all levels of the Nation's socio-economic lives. The urgent need for public awareness creation, institutional strengthening and partnership with international agencies for sustainable energy efficiency promotion measures in Nigeria is stressed.



The Drying Characteristics of Cassava and Tatase in a Three-Chamber Solar Food Dryer.

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Abstract

A three-chamber solar food dryer has been designed and constructed with locally available materials. A seven-day long test run between 12th -18th March, 2009 shows that within the hours of 10.00am and 6.00pm the collector temperature could vary from 34°C to 46°C while the ambient temperature varied from 30°C to 39°C. On the other hand, the drying chamber temperatures ranged from 32°C to 47°C. The devise was used to dry cassava slices and tatase. The drying parameters of the produce such as the dimensionless mass loss, the moisture content, the drying times as well as their mass shrinkage ratios were determined. Accordingly the drying curve equations for cassava and tatase in each of the three drying chambers were established and discussed.

Keyword: Solar dryer, cassava, tatase, dimensionless mass loss, mass shrinkage ratio, moisture content.

The Potentials for Land Subsidence in the Niger Delta Basin, Nigeria

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Abstract

The Niger delta basin, Nigeria has over 250 oil and gas fields from over 500 exploration campaigns. The potentials for land subsidence as a result of fluid extraction are evaluated and discussed based on data obtained from pumping test during well testing programmes based on measured changes in hydraulic head aquitard compaction of between 1400mm and 3000mm per year estimated. In spite of the uncertainties in the compressibility value, it is apparent that aquitard compaction and hence land subsidence may well be a real problem in the oil well fields of the Niger delta, Nigeria. Such subsidence problems have the potential to cause coastal erosion and apparent sea level rise. The implied subsidence has even a more far reaching implication when the effect of sea level rise due to climate change/ global warming are taken into consideration. It is therefore suggested that survey benchmarks and soil compaction recorders be installed in the area in order to monitor land surface deviations

Energy-Saving Chemically Deposited Solar Control Coatings For Architectural And Other Applications

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Solar control coatings are required for architectural and automobile glazing applications in the a warm climate to realize cool interior in buildings. Such coatings must provide controlled optical transmission ($\sim 10\text{-}35\%$) of solar radiation in the visible region and should reflect efficiently in the infrared ($>0.70\mu\text{m}$) region of the electromagnetic spectrum to achieve energy efficiency in the buildings and automobiles. Optimal coatings based on single or multilayers of Cu_xS , Bi_2S_3 , PbS , SnS , NiS , ZnS , etc, deposited on glass have shown a range of solar control characteristics – superior or comparable to those of metallic solar control coatings, the integrated IR transmittance is low, $\sim 10\%$ and the very low visible integrated reflectance, $<10\%$, avoids glare problems. The low-cost and simplicity of the deposition technique and the versatility of the characteristics make these metal chalcogenide films desirable in solar control technology. In addition to solar control applications of the above films, their prospect in decorative coating, low-cost all-glass evacuated tube solar collectors, etc, are also discussed.

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Palm Oil Biodiesel, a Potential Fuel for Agricultural Products Processing In Rural Farming Communities in Nigeria.

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A Self-Regulating System for Microalgal Mass Culture for Energy Generation

L. O. Eke and G. C. Njoku

Biotreatment of Organic Waste Materials: An Effective Recycling Technology for Biogas Production

Chukwuka I. Nwoye

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J.C. Nnokwe and V.I. Ibekwe

The Use of Rapeseed Methyl Ester Biodiesel in Diesel Engines

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Biogas Production for Cooking and Electricity Generation

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Design and Construction of Briquetting Machine for Fuel Production Using Agricultural Waste

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Empirical Study on Optimizing Energy Recovery from Oil Palm Waste in Nigeria

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Kinetics of Biogas Potential from Animal and Domestic Waste

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