

## CONSERVATION OF ENERGY IN A GROWING ECONOMY

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### ABSTRACT

The demand for energy is rising rapidly with growing population and industrialization. Conservation of energy has become increasingly important as energy usage rates and shortages have increased. This is compounded by limited availability of non-renewable energy sources like fossil fuels ( coal, petroleum, natural gas ), firewood and other secondary non-renewable energy sources. There is the need to sensitize the public on ways to conserve-maximize the use and avoid or minimize wastage of energy. Nigeria presently generates a little above 3000MW of electrical power. The power generated is far less than what our present population of about 150 million people need for domestic, industrial and transportation usage. This study highlights the role of efficient transport system in conservation of petroleum products. Also many house appliances were examined and ways of conserving electrical energy in them recommended. This paper also highlights prudence on the part of energy users as a way of saving cost and avoiding wastages. Although what we generate is far less than what we need, if these measures are implemented, more energy will be saved. Less burning of fossil fuels also means lower emissions of carbon-dioxide CO<sub>2</sub>, one of the primary contributors to global warming, and other pollutants. Increased power generation as well as alternative means of energy generation using renewable sources like solar, wind and biomass is encouraged, so that our natural resources will be available for future generations.

**Keywords:** energy, conservation, efficient, economy

### INTRODUCTION

Energy is the ability or capacity to do work. Work is performed when a force act on an object and it moves. In other words, work is energy in transit. Power is the rate at which work is done. Energy can be observed in various forms and according to the law of conservation of energy, energy can neither be created nor destroyed but can be transformed from one form to another. (Seaway and Faughn, 2003 ). For example, energy is stored or exists as chemical energy in premium motor spirit ( gasoline), when it is burnt in internal combustion engine ( car engine ), it is converted to mechanical energy that turns the crankshaft and causes the car to move. Thus a heat engine is a device that converts internal energy to mechanical energy, according to the equation,

$$Q = \Delta U + W \quad (1)$$

where Q is the net heat input

$\Delta U$  is the change in internal energy

W is the net work done

Equation (1) is the first law of thermodynamics and it is an expression of the principle of conservation of energy (Beiser, 2004 ).

Non-renewable energy sources are natural resources that cannot be replenished, they include fossil fuels : coal, petroleum and natural gas. Firewood is also a non-renewable resource. Fossil fuels can be used to generate heat and electricity. This paper examines the conservation of secondary (usable) non-renewable energy in Nigeria and other parts of the world.

Energy management can be defined as the art and science of optimum use of energy to maximize profit (minimize cost) and thereby improve the economic competitiveness, (Rao and Parulekar, 2007). In general, energy management involves strategy, policy, planning, energy conservation measures, etc:

Strategy refers to the path of action to be

taken and tactics to be used from available options. For example, if a Nation does not have petroleum natural resources, the strategy may be to develop nuclear technology or bio-energy resources.

Policy refers to the official plan, guideline for course of action to be taken.

Planning refers to detailed formulation of various actions in given time frame to achieve the objectives.

Energy conservation involves avoiding wastage of energy and adoption of methods to save energy without affecting productivity and comforts. The discussion focuses on secondary non-renewable energy conservation. Secondary energy sources or usable energy are those supplied to the user for consumption, they include electrical energy, petroleum oils, liquid petroleum gas, steam, hot water, fire-wood etc.

The need to conserve energy arises as a result of the rapid rise in energy demand due to growing population and industrialization. Because of the limited amount of non-renewable energy sources available, it is important to conserve our current supply and to use renewable sources so that our natural resources will be available for future generations. Energy conservation is also important because consumption of non-renewable sources causes negative impact on the environment as the use of fossil fuels contributes to air and water pollution. For example, carbon-dioxide  $\text{CO}_2$  is produced when oil, coal, and gas combust in power stations, heating systems, and car engines. Carbon-dioxide in the atmosphere acts as a transparent blanket, that contributes to the global warming of the earth or "greenhouse effect" this warming significantly alter our weather (Akerman and Knox, 2003). Possible impacts include threat to human health, environmental impacts such as rising sea levels that can damage coastal areas, and major changes in vegetation growth patterns that could cause some plants and animal species to become extinct (Montgomery, 2003). Sulphur dioxide  $\text{SO}_2$  is also emitted into the air when coal is burned. The sulphur dioxide reacts with water and oxygen in the clouds to form

precipitate known as "acid rain". Acid rain can kill fish, trees, and damage vegetation, limestone buildings and materials (Tiwari, 2007). These problems can be reduced if adequate energy conservation methods are implemented as discussed below.

## **CONSERVATION OF PETROLEUM PRODUCTS**

Nigeria's economy is a growing economy, so most goods consumed here are imported from overseas and transported to various distribution points and cities. Agricultural products produced in the countryside have to be transported to cities where they will get ready buyers. Transportation sector naturally leads in the conservation of petroleum products.

Railroads have to be expanded and new ones constructed to transport people and goods to distant destinations. Take for example, the carriage of 100 tonnes ( 1 Ton = 1000kg ) of goods from Apapa port in Lagos to Aba, a city in the south-eastern part of Nigeria, the volume ( i.e. cost ) of petrol/diesel consumed by the vehicle will be much larger than if they were to be transported by train , which will also carry heavier loads. Agricultural products from different parts of the country can be distributed with less cost, that is, less petroleum products consumption if we have efficient and effective railroad transportation. Consequently, petroleum products will be highly conserved and channelled to other areas of need. Also, transportation of people to distant places in the country can be best done by efficient rail-transport system than road-system. The cumulative effects will be low cost transportation, pollution reduction and low rate of accident favours railroad transportation system.

Road network should be developed and deplorable ones repaired. If the states of roads are good and comfortable buses made available, people should be encouraged to travel in public vehicles. This has been recently exemplified by the present administrations in Lagos and Delta states which introduced comfortable and efficient metro transport for the people of the states. This will go a long way in conserving petroleum products, reduce other negative

effects of traffic jams on our roads and emissions of pollutants. Other States of the federation that have not introduced the metro transport system should emulate the two State governments while states with existing transport system should expand and sustain the metro transport system.

Taxi pool is a situation where taxis converge in a park and commuters board the taxi, instead of all the taxis being on the road at same time. This will also save lots of fuel and reduce pollution in the environment.

Information and communication technology (ICT) should be developed. ICT has a major role to play in energy conservation. People can communicate while at home instead of embarking on journeys. Businesses can be contracted and discussions finalized through telephone calls, conferencing and e-mails. More methods of energy conservation and exchange of ideas can be learned through the internet. The combined result will be conservation of fossil fuels and reduction of other negative effects that follow.

Government and private organisations can build housing estates near the work place for their workers and provide buses to convey the workers to and fro from the work place to avoid long journeys to work. This will lead to saving of petroleum products. People are also encouraged to drop their vehicles and trek during short distance picnics. This will improve health and wellbeing and conserve fuel as-well.

### **CONSERVATION OF ELECTRICITY**

Electricity is the flow of electric charge, the charge can be positive or negative. Electric current is the flow of electrons: if the current flow is in one direction, it is called a direct current (DC) while if the flow reverses direction, it is known as alternating current (AC). Alternating current has many advantages and uses over direct current. The main advantage being that it can be transmitted over long distance, with some power losses due to resistance and heating in the power lines. So all discussions in this paper is essentially alternating current. Electrical power plays a piv-

otal part in domestic and industrial life of the modern man, as lighting, heating, cooling, operation of machines and appliances, etc, depends directly or indirectly on electrical power.

Electrical energy is a major usable energy supplied to users for consumption. Appliances commonly found in the home are listed first and the various ways to conserve-maximize their energies discussed below.

**Air conditioners:** Check and clean the air-conditioner's filter once a month; make sure the air-conditioning unit is the proper size for the room it is cooling; locate the air conditioner on the north or east side of a house in a shady area; ventilate the house's attic (the room directly under the roof) to reduce heat build-up; install ceiling fans to improve air circulation.

**Refrigerators:** Check door seals to make sure there are no air leaks, otherwise, warm air will get in and the unit will have to work harder to keep things cool, costing more energy. Clean condenser coils on the back of the refrigerator; keep refrigerator away from oven or dishwasher and give unit breathing room; keep the refrigerator section at between 2 C and 5 C ( 36 – 42 °F ), turn thermostat down to 2.8 C ( 37 °F ), and the freezer at -18 C ( 0 °F ). These temperatures help ensure food safety, but lowering the temperature further only wastes power. Don't over crowd the fridge or freezer, freezers should not be more than 2/3 full. Also, don't spend time and waste electricity by "grazing" in front of the refrigerator with the door open to browse through it's contents.

**Ovens and Stovetops:** Use microwave instead of oven where possible, because cooking with a microwave oven typically uses less than half the energy of an electric stove/oven. All that heat being given off of the stove is wasted energy, food in glass dishes can be cooked at lower temperature; preheating oven is usually unnecessary; on the stove top cook with covered pans and match pan size to the size of the burner, and where possible, use an electric kettle rather than a stovetop one.

Heating effects consumes more power (Young et al, 2006), from the equation,

$$W = I^2Rt \quad (2)$$

where , W is the energy ( heat )

I is the current

R is the resistance of the material

T is the time

The implication is that consumers should use less hot water.

**Lights:** Replace incandescent bulbs with screw-in fluorescent bulbs, which use 75% less electricity and last at least 8 times longer; turn lights off when not needed; install light dimmers or photoelectric switches that automatically turn off lights during daylight or install timers to control use of lights; for lights use for home security, install motion detectors so light come on only when motion is detected. Dust your lamps and light with the power off. Even a thin layer of dust reduces light levels.

**Clothes Washers and Dryers :** Use only with full load ; use warm or cold water, reserving hot water use for heavily soiled clothes; use only full load for the dryer and if a second load is necessary, dry that load immediately after the first to retain as much heat as possible; clean lint filter before each load

**Water Heaters:** Lower the heater setting to 48 °C - 54 °C (120-130 °F); insulate the water heater and any exposed hot water pipes; use low-flow shower heads.

**Dish Washers:** Wash only full load; turn off drying cycle, open door to air dry dishes.

**Computers:** Turn off computers when not in use or set the computer to energy-saving mode. Laser printers can really run up power bills, so keep your printer turned off using the switch on the printer, when not in use. Some printers take as much power as 600 Watts. Sparingly use a hairdryer and don't use the maximum heat setting.

Use curtain and shades on your window, to keep the heat in during cold weather.

Use window shades to reduce or block sunlight and heat during hot weather, especially if you have windows that receive direct

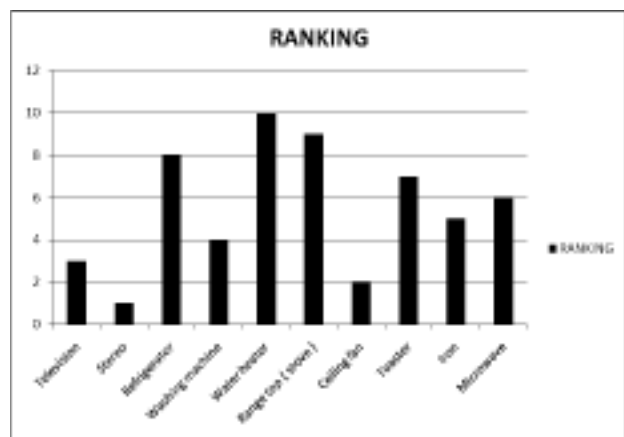
sunlight.

Unless absolutely necessary, use a fan rather than air conditioner during hot weather.

Replace aging appliances with new, more energy-efficient models when possible; look for energy star label designating an energy- efficient appliance.

Table 1: List of common household Appliance and their ranking, the appliances are ranked from 1 ( lowest) to 10 ( highest). ( Source: United States Environmental Protection Agency, 1997 ).

APPLIANCES	RANKING
Television	3
Stereo	1
Refrigerator	8
Washing machine	4
Water heater	10
Range top ( stove )	9
Ceiling fan	2
Toaster	7
Iron	5
Microwave	6

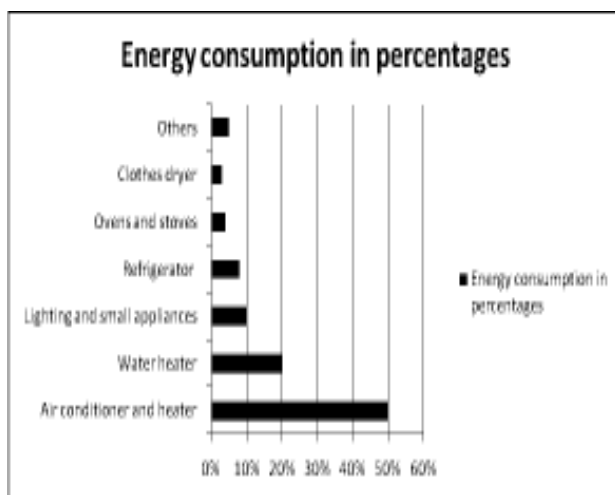


**Fig.1: representation of the ranking in a bar chart.**

In a home where electricity supplies all of the energy requirements, the energy consumption is shown below:

- Air conditioner and heater = 50%
- Water heater = 20%
- Lighting and small appliances = 10%
- Refrigerator = 8%

Ovens and stoves = 4%  
 Clothes dryer = 3%



Others = 5%

**Fig.2: Representation of energy consumption of a typical home in a bar chart**

It is recommended that energy audit be done at homes and offices occasionally to know the cost of energy consumed at certain seasons. Industries should use power saving machines and replace aging ones where possible. Electrical power from the national grid or independent power providers is advocated for manufacturing companies than generating sets that consume lots of fuel. With these, petroleum products and electricity will be conserved.

To conserve firewood used as fuel, the methods used to save energy apply; bulk cooking/heating, heat conservation, etc. More importantly, for every tree cut, new one should be planted.

**CONCLUSION**

Methods of energy conservation cannot be exhausted as new methods keep emerging with advances in technology, but the methods discussed cannot be overemphasized. More energy will be saved and less pollution emission if these ways are followed. While advocating energy conservation, this paper high-

lights the need to build more power stations as present power ( about 3000 MW ) is far less than what we need. Alternative sources is also advocated, we have abundant sunlight especially in the northern part of the country, solar energy can be harnessed and converted to electricity and heat. Windmills can be built in the windy regions of the nation, wind-turbines converts mechanical energy to electricity. Biomass (organic wastes) can be converted to biogas ( methane and carbon-dioxide ) methane CH<sub>4</sub>, is a rich fuel gas, residues from biogas plants can be used as manure. If these and more renewable energy are harnessed, there will be energy conservation of trees and plants which would be used as fuel, and conservation of fossil fuels and electrical energy from conventional power plants. Our environment will be better for habitation.

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