

## TRANSLATING LESSONS FROM THE PEAK OIL THEORY TO POLICIES IN THE NIGERIAN BUILDING SECTOR

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### Abstract

The world petroleum resources are becoming depleted, and probably would develop into a kind of development theory rather than a crisis theory, which promotes; reasonable utilization of the limited resources and encourages the researches into alternative sources of energies. This paper set out a theoretical frame work of energy usage in Nigeria building sector through a critical analysis of current scenario on existing situation of generation and deregulation of the downstream oil sector as well as the way forward in developing alternatives sources of energy in the building sector. Policies and guidelines which will provide a common framework to integrate renewable alternative energy into the energy technology mix and the building sector are proposed; a role needed to be played not only by science but a collaborative effort among the entire academia, government institutions and stakeholders as a paradigm shift on approach to energy crises in Nigeria a countermeasures against peakoilism could enhance the a massive growth in the building sector by incorporating some lesson from the peakoil theory in building codes and guidelines in the construction sector

Keywords: Building sector, Nigeria, Peakoilism & Policy

### Background to the Study

#### Climate Change and Global Warming

Climate change is a critical global environmental problem which attracted the world and policy makers in the international globe. Exploring climate change means touching upon issues at the core of the sustainable development. Since the United Nations Framework Convention on Climate Change (UNFCCC), was signed in 1992 the sole aim was to reduce greenhouse gas emissions and assign responsibility amongst various countries (Dawson and Spannagle, 2009). African continent contribute 3% of total greenhouse gas emissions making them the smallest contributor to the problem, while Nigeria emit the most of all African because of gas flaring of unwanted natural gas with 49 million tons of greenhouse gases from Nigeria IEA (International Energy Agency 2008) [www.scienceinafrica.co.za](http://www.scienceinafrica.co.za) The transition from the fossil fuel age to whatever comes after it, energy prices will rise and the hardest hit buildings will be those built in the last half of the twentieth century with building in the fore front of consumption (Roaf, et al., 2010) Nigeria flares 75% of the natural gas it

produces. Traditional biomass (largely wood fuels) accounts for the largest share of total energy consumption (51%) followed by petroleum products (41%), natural gas (5.2%), and electricity (3.1%). These are all non-renewable form of energy and the need for alternatives is an important quest for addressing this century global challenges.

Total installed electricity capacity is estimated at 5.9 GW with about 40% of the population having access to electricity (82% in urban areas and 10% in rural areas). Electricity in West Africa is generated through thermal (58.8% of installed capacity) or hydroelectric (41.2%) resources. Natural gas has the potential to take a more significant role in the region's energy sector as fields in Nigeria.

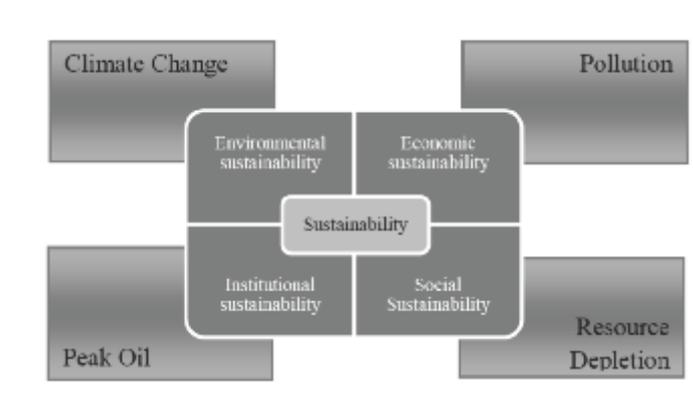


Figure 1: Level of Emission Scenario (Source: Dodo et al., 2010)

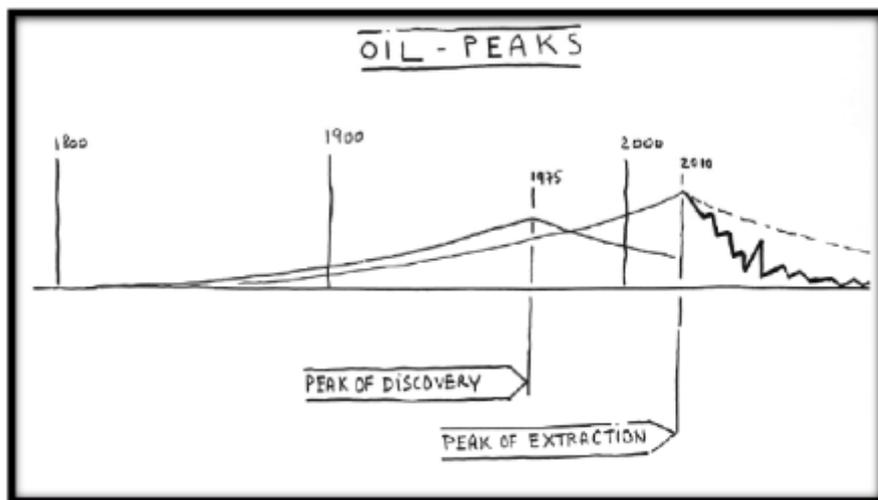


Figure 2: Global Resource; the Long Emergency in Leon Krier (Source: Isherwood 2010)

The most paradigmatic global environmental changes is the continuous rise of carbon-dioxide (CO<sub>2</sub>) emissions to the troposphere from fossil fuel burning and has being the dominant cause of observed anthropogenic global warming, Okali, (2008) and Intergovernmental Panel on Climate Change- IPCC- (2007). The global peak oil will easily result in acute economic, social, and environmental problems associated with increase in the price of oil and the desperate demand for alternatives to fill the gap.

As the world continues to industrialise rapidly, demand is increasing year on year, particularly in countries such as Malaysia, Nigeria, China and India. However, it is the United State which accounts for the majority of the planet's oil usage. 25% of oil used in 2006 was consumed in the US, and demand is still rising. This poses a problem for a rapidly industrialising society, as oil is a finite resource. So far, this process has not been recreated successfully in a laboratory, within compressed time conditions. We must assume then that the oil currently in the ground is all we are going to get. The supply and demand of oil, therefore, has huge political and economic significance, and those controlling the supply can wield tremendous economic and political power (Hubbert, 1956a; Bardi and Yaxley, 2005)

### Empirical Literature Review

#### The peak oil theory

The Hubbert peak theory is based on the observation that the amount of oil under the ground in any region is finite; therefore the rate of discovery which initially increases quickly must reach a maximum and decline. The Hubbert peak theory says that for any given geographical area, from an individual oil-producing region to the planet as a whole, the rate of petroleum production tends to follow a bell-shaped curve. It is one of the primary theories on peak oil. Peak oil as a proper noun or "Hubbert's peak" applied more generally, refers to a singular event in history: the peak of the entire planet's oil production. After Peak Oil, according to the Hubbert Peak Theory, the rate of oil production on Earth would enter a terminal decline. On the basis of his theory, in a paper (Hubbert, 1956b) he presented to the American Petroleum Institute Hubbert correctly predicted that production of oil from conventional sources would peak in the continental United States around 1965-1970. Hubbert further predicted a worldwide peak at "about half a century" from publication

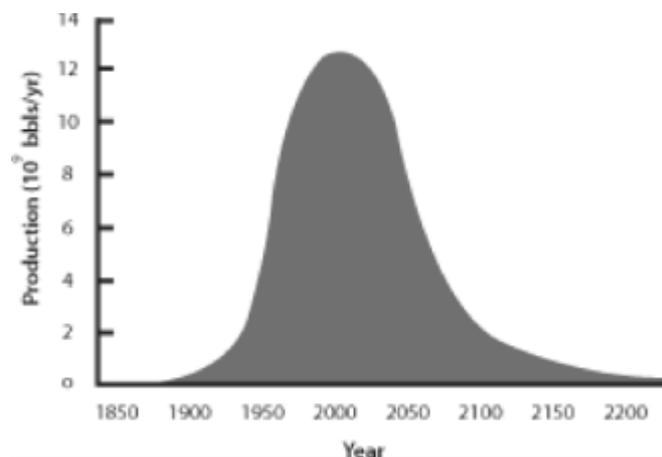


Figure 3: The Hubbert peak projection for 2200 (Source: Hubbert, 1956b)

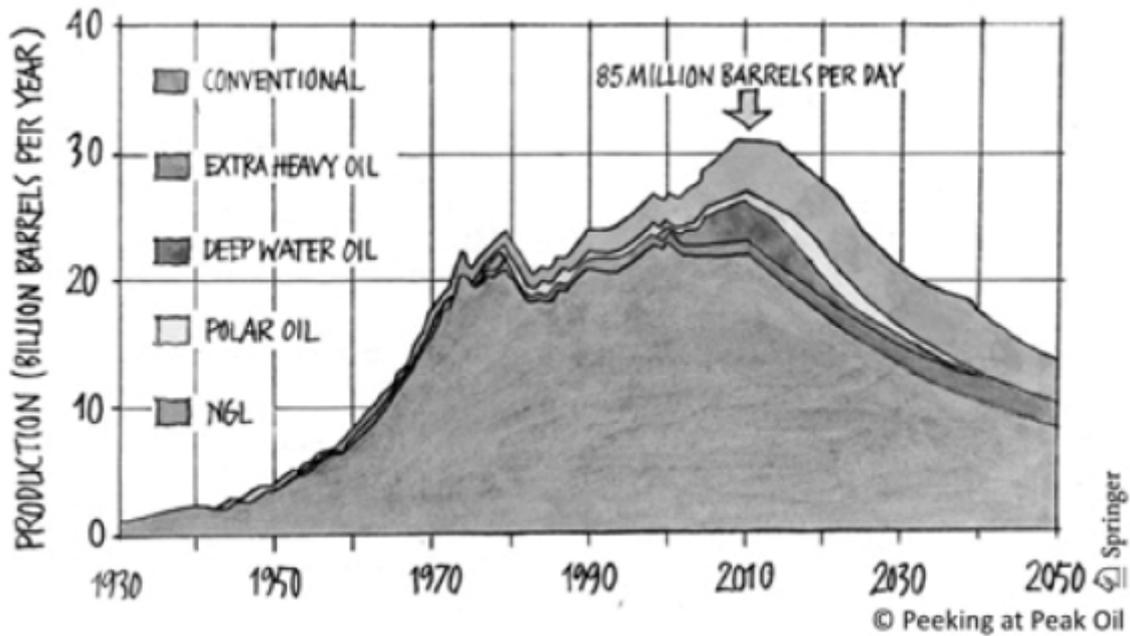


Figure 4: Global Resource presentation of the book peeking at Peak Oil (Source: Aleklett 2012)

Given past oil discovery and production data, a Hubbert curve that attempts to approximate past discovery data may be constructed and used to provide estimates for future production. In particular, the date of peak oil production or the total amount of oil ultimately produced can be estimated that way. Cavallo (2004) defines the Hubbert curve used to predict the U.S. peak as the derivative of:

$$Q(t) = \frac{Q_{\max}}{1 + ae^{-bt}} \dots\dots\dots(1)$$

Where  $Q_{\max}$  is the total resource available (ultimate recovery of crude oil),  $Q(t)$  the cumulative production,  $a$  and  $b$  are constants. The year of maximum annual production (peak) is:

$$t_{\max} = \frac{1}{b} \ln(a) \dots\dots\dots(2)$$

This is where the cumulative production  $Q(t)$  reaches the halves of the total available resource:

$$Q(t) = Q_{\max}/2 \dots\dots\dots(3)$$

One of the weaknesses of the peak oil theory is that it can't really be used to determine when the peak will occur many years after the fact it will be obvious but the theory does little to predict the future. This means that nobody really knows when oil will peak. Some people argue that it has already happened while others argue that it won't happen for at least another decade. Regardless the fact remains that it will happen and even the most optimistic predictions suggest that oil production will peak within the next ten years. Therefore action needs to be taken immediately to ensure that we are prepared for rising oil prices.

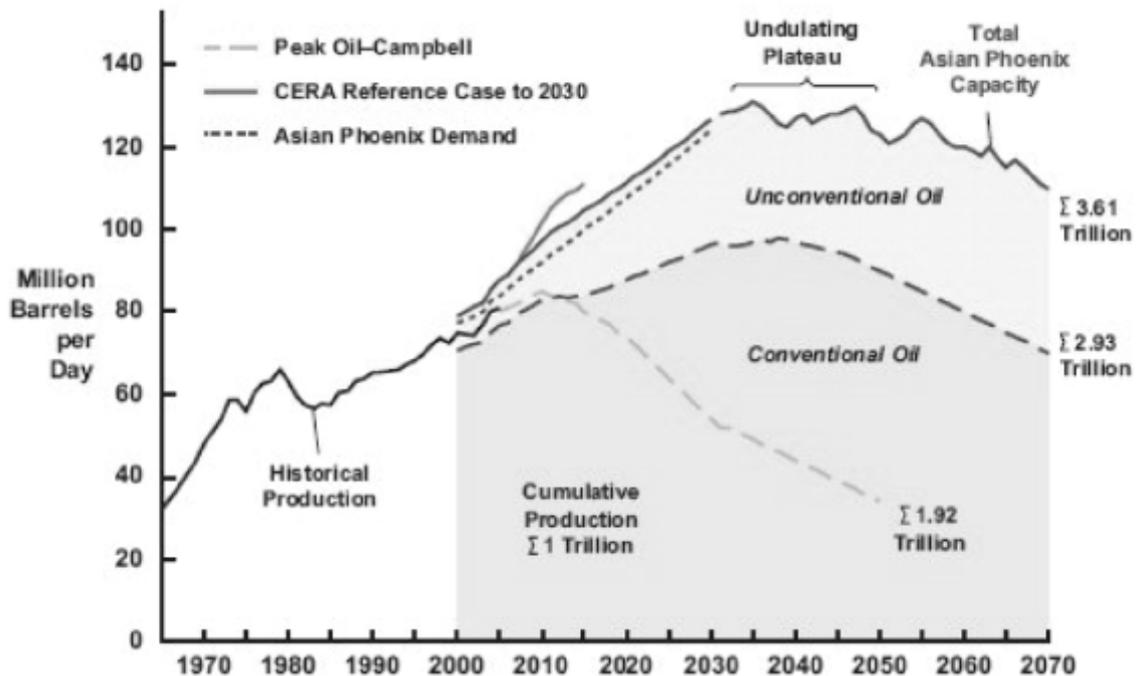


Figure 5: Undulating Plateau versus Peak Oil (Source: Cohen, 2007)

#### Criticism of the peak oil theory

The theory was initially regarded with scepticism by the oil industry, but since then, has gained fairly widespread acceptance. This was helped by the fact that US oil production hit its peak in 1970, around the time that Hubbert's model predicted.

The theory doesn't take into account, improvements in technology that make extracting oil cheaper and more efficient. Oil that 50 years ago may have been uneconomical to extract, could now be recovered because of the increased accuracy of surveys and the improved quality of drills and drilling methods.

The original peak in global oil production was initially predicted to be in 2000, and was then pushed back to 2010. A 2006 report from the Cambridge Energy Research Associates criticised the usefulness of Hubbert's model, saying, Despite his valuable contribution, Hubbert's methodology falls down because it does not consider likely resource growth, application of new technology, basic commercial factors, or the impact of geopolitics on production.

In a more basic sense, there are some who question Hubbert's basic assumption that oil is a finite resource. In Russia and the Ukraine, many scientists subscribe to the abiogenic petroleum origin theory. (Abiogenic petroleum origin is a hypothesis that was proposed as an alternative mechanism of petroleum origin. According to the Abiogenic hypothesis, petroleum was formed from deep carbon deposits, perhaps dating to the formation of the Earth (Glasby, 2006) This rejects the notion that oil comes from compressed plant and animal fossils, and postulates that oil is produced on a constant basis from chemical reactions among carbon deposits in the earth's crust

The most criticism come from the facts that Lynch (2013) believed that the Hubbert curve is too simplistic and relies on the Malthusian point of view, while Maugeri (2004) argue that the theory does not put into account Unconventional oil Luttwak, (2006) an economist and historian, claims that unrest in countries such as Russia, Iran and Iraq has led to a massive underestimate of oil. The Association for the Study of Peak Oil and Gas (ASPO) responds by claiming neither Russia nor Iran are troubled by unrest currently (Laherrere, 2005).

Peak oil is affecting the oil-dependent economies which have an alarming implication for climate change oil, of course, doesn't mean that the world is running out of oil any time soon. There is a vast amount of oil left. Over the last 150 years, however, we've picked the low hanging fruit, so to speak, meaning that the remaining oil is harder to find and more expensive to extract. This is making it more difficult to increase the "flow" of oil out of the ground. When the rate of crude oil production cannot be increased, that represents peak oil. This is considered by many to signify a defining turning point in history, because oil demand is expected to increase as the world continues to industrialise. The theory goes that, as the supply of oil stagnates and the demand increases, the cost per barrel will rise, making the consumption of oil an increasingly expensive and debilitating addiction (Alexander, 2013)

#### Analysing the criticism

We must acknowledge that high oil prices are here to stay. Even if the Hubbert theory cannot accurately predict when peak production will occur, it is clear that demand is increasing as supply seems likely to decrease. It therefore seems sensible to identify potential alternatives to oil, and we should also seek to limit the amount of oil based products (petrol) we use, taking advantage of other source of energy that can be use in the building sector. We can also use our democratic power to urge the government to change its policy regarding petrol prices. Whether Hubbert's theory is correct or not, we must ensure that our society can function with dwindling supplies of black gold.

#### Problem Statement and Theoretical Framework

In 2007, (Goldman Sachs) looked at the economies of the world and made a prediction of world economy potentials, he predicted that most economies will outplay the big economies if they continue on such path of growth rate and that Nigeria will be the 12th largest economy by 2050, this made the Nigeria government plan for 2020 in lieu of 2050 prediction (Nwachukwu, 2009). Vision 2020:20 a milestone for Nigeria energy sector, for developmental growth the issue of energy efficiency wasn't established, except the issue of deregulation (Soludo, 2007) to achieve this goal alternative source of energy would be a priority, since energy is a drive and a major key player in any meaningful economy system.

The overall management of Nigeria's mineral and energy resources remains the primary assignment of the Government through its various agencies. Like, the Power Holding Company of Nigeria (PHCN). The current installed capacity of grid electricity is about 6000MW, of which about 67 percent is thermal and the balance is hydro-based. Between 1990 and 1999, there was no new power plant built and the same period witnessed substantial government under-funding of the utility for both capital projects and routine maintenance operations. Generating plant availability is low and the demand – supply gap is crippling. Poor services have forced most industrial customers to install their own power generators, at high costs to themselves and the Nigerian economy.

The Ministry of Science and Technology has prepared a National Energy Policy that places emphasis on the exploitation of Nigeria's renewable and alternative energy sources as well as provides guidelines for environmental protection in the exploitation of Nigeria's fossil energy sources. It is increasingly an important gas province with proven reserves of nearly 5000 billion cubic meters. Coal and lignite reserves are estimated to be 2.7 billion tons, while tar sand reserves represent 31 billion barrels of oil equivalent. Identified hydroelectricity sites have an estimated capacity of about 14,250MW. Nigeria has significant biomass resources to meet both traditional and modern energy uses, including electricity generation. The country is exposed to a high solar radiation level with an annual average of 3.5–7.0 kWh/m<sup>2</sup>/day. Wind resources in Nigeria are however poor - moderate, and efforts are yet to be made to test their commercial competitiveness.

## Terminologies

### 1 Oil

In context of oil production, the definition for used crude oil, shale oil, oil sands and NGLs (natural gas liquids—the liquid content of natural gas where this is recovered separately). In context of oil consumption, crude oil, condensates, natural gas liquids, refinery feed stocks and additives, other hydrocarbons and petroleum products (refinery gas, ethane, LPG, aviation gasoline, motor gasoline, jet fuels, kerosene, gas/diesel oil, heavy fuel oil, naphtha, white spirit, lubricants, bitumen, paraffin waxes, petroleum coke and other petroleum products).

### 2 Cumulative production

The cumulative production is the sum of all oil that has ever been produced until a specific date. Cumulative production can be given for a field, oil basin, country or the world.

### 3 Decline Rate

The decline rate refers to production only. It is defined as the negative relative change of production over a time period. Often a period of a year is used. The decline rate can be expressed as a fraction or as percent.

Assume a production of 1 Gb in year 2007 and 0.95 Gb in year 2008. The decline rate for year 2008 would then be  $(1 - 0.95) / 1 = 0.05 = 5\%$ . If the production is rising, the decline rate becomes negative.

#### 4 Depletion Rate

The depletion differs from the decline rate in that it takes into account the amount of oil that is left. The depletion rate is defined as this year's production divided by the amount of oil that is left

#### 5 Peak Oil

The term Peak Oil refers to the maximum rate of the production of oil in any area under consideration, recognising that it is a finite natural resource, subject to depletion.

#### 6 Production

Production refers to the amount of oil that is produced during a certain time period (most often a day or a year).

#### 7 Recoverable Reserves (Estimated future production from known fields)

The recoverable reserves are an estimate of how much recoverable oil is still left in the already found oil fields. It can only be an estimate since it's impossible to know exactly how much oil is still in the ground. Because of this uncertainty, reserves are calculated with a certain probability.

### Methods

This paper set out a theoretical frame work of energy usage in Nigeria through a critical analysis of current scenario on existing situation of generation and deregulation of the downstream oil sector as well as the way forward in developing alternatives sources of energy in Nigeria through translating lessons from the peak oil theory to policies in the Nigeria building sector.

### Result Analysis and Discussion

#### 3.1 Countries considering peak oilism

The United State of America is in the fore front on the usability of the peak oil as well as Georgian although there are been so many criticism about the theory of peak oilism. Many countries have translated this theory lessons in different ways in their building sector. As it is clear that it is partially responsible for climate change in the sense that peak oil is affecting the oil-dependent economies which have an alarming implication for climate change as well. Most countries through the world green building council (WGBC) have introduce the green building by having a rating system for individual country; which is sweeping across many countries with it aim at reducing the dependency of the use of petro and it by products in the construction industries.

Countries that have initiated the green building ideology are; (USA, Canada, Australia South Africa, Singapore, Malaysia, China, Vietnam, Japan, Hong Kong etc.)

#### Lessons from peak oilism

Some lessons from the peak oil theory are well evident in the Nigeria economy and other sector especially the building sector; this lesson could be champion into guidelines and policies that can

- 1) High oil prices are here to stay.

- 2) It is clear that demand is increasing as supply seems likely to decrease.
- 3) Identify potential alternatives to oil; seek to limit the amount of oil based products (petrol) we use.
- 4) The tapping into other renewable source of energy that can be use in the building sector.
- 5) That our society can function with dwindling supplies of black gold (Petroleum)

#### Proposed framework on the usability of lessons from Peak Oil theory

##### Adaptation to the situation

This is an economist point of view; whereby determining what are the benefits that the theory of peakoil theory would bring to the Nigerian economy if properly addressed in the building sector

##### Prevention of the situation

The environmentalist point of view is that we need to protect our environment in the most economical way we can considering the theory as a step forward in realising what harm the petrol as source of energy pose to the environment

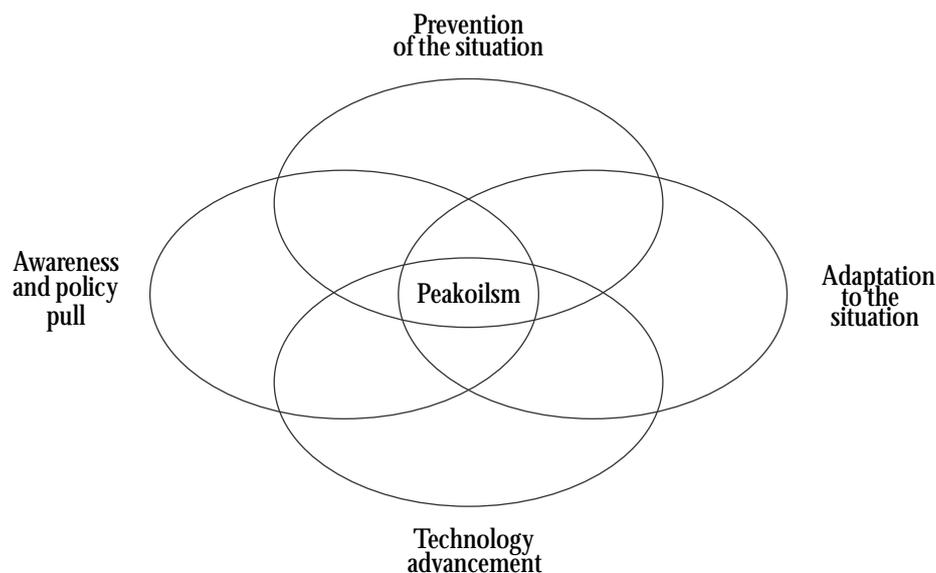


Figure 6: Proposed framework on the usability of lessons from Peak Oil theory

##### Technology advancement

Artisan would have to be IT literate, low carbon buildings, carbon – foot printing, health and safety would be of priority as well as a mobile computing and ICT.

##### Awareness and policy pull in the Nigeria building sector

There would be a huge awareness on the issue of how to go about the lessons learn from this theory by translating it into various guidelines and codes in the building sector. The energy used to heat and power our buildings leads to the consumption of large amounts of energy, mainly from burning fossil fuels -oil, natural gas and coal -which generate significant amounts of carbon dioxide (CO<sub>2</sub>), the most

widespread greenhouse gas. Reducing the energy use and greenhouse gas emissions produced by buildings.

#### Recommendations and Conclusions

Reducing the use of fossil fuel (alternative sources) are needed for our energy consumption which would be a probably drive for the scientific revolution in the 21st century global challenges and a countermeasure against peakoilism. Building green involves creating structures and using processes that are environmentally responsible and resource efficient throughout a building's lifecycle, from site to design, construction, operation, maintenance, renovation and deconstruction. Green buildings can reduce energy use by 24-50 % per cent, carbon dioxide (CO<sub>2</sub>) emissions by 33-39% water use by 40% per cent and solid waste by 70 % per cent: there are business benefits too, such as; decreases in operating costs, increases in building value and return on investment by percent. Policies and guidelines are required, which will provides a common framework to integrate these renewable alternative energy into the energy technology mix (Uyigüe et al., 2009); a role needed to be played not only by science but a collaborative effort among the entire academia, government institutions and stakeholders as a paradigmatic shift on approach to energy crises in Nigeria.

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