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Housing Design and Implementation: a Panacea to Energy Problem in Yobe Sahel

Joseph Kehinde Binuyo M.sc URP, A.N.I.V.S, R.S.V
Department of Estate Management,
Federal Polytechnic Damaturu, Yobe.

Abstract
Housing is combination of shelter, infrastructure and services provided and enjoyed by dwellers of the accommodation. This paper then focuses on an aspect of services to the shelter, that is, energy. It explored how housing design could ameliorate the cost of lighting and cooling in Yobe Sahel. Housing is conceived as a system, the combination of shelter, infrastructure and services. Design tools like Plot coverage to building; air space; room standard; building orientation; and energy cost analysis. The consequence of energy based design shows that cost expended on lighting at day-time is reduced while cooling at hot season is also ameliorated via construction material used. Thus, an energy based design though initially capitally intensive to execute, it has a long time benefit of reducing energy cost and promote eco friendliness.

Keyword: Housing, Space standard, Energy

Background to the Study
Housing has a complex definition. There is no generally acceptable means of defining it but some scholars views about housing is worthy of note. Olatubara (2007) sees housing as one of the indispensable physiological needs of man that shares essential qualities with food and clothing. This physiological need has ever been primary desire of the ancient (earliest) man on earth whose conscious act inspired him to quest for a cave, put up timber members and take all manner of steps to get a cover over his head thus shielding himself from the adverse element of weather such as the sun, rain even cold. This psychological drive has progressively transcended to generation / descendant after him. They crave for housing and this has gone beyond a mere want of shelter but for various purposes such as include prestige, status grouping, aesthetic accommodation, commercial edifices, tourist and lot more thus, making housing very essential in human world as well as animal clime (animal in zoo and domesticated animal).

Agbola (2007) is of the opinion that housing is a structural component of a physical house and all the services that makes it habitable for man. The services include all that makes the accommodation habitable but not limited to good road; potable water; compatible landscape and other infrastructures like energy of which this article is concern. It was gathered that Africa as a continent has a population of about 885million people which is equivalent to United State of America, Europe, Brazil, Japan and Australia all put together yet her gross energy is one-eleventh, one-sixth, and one- half of the energy used by a North American, Europe and Latin American respectively. One then wonder, why 'giant' in population should be poorly 'nourish' energy-wise despite the sufficient energy potential within her environs (Davidson et al, 2006, C.I.A, 2008).

Nigeria is a core example where energy per capita stood at 140kwha against 1,337 and 4,560kwh of Egypt and South Africa respectively (Iwayemi, 2009). Her socioeconomic sector is greatly affected as many industries have closed 'shop' (Guinness, Dunlop etc. now produce in Ghana); small and medium enterprise are gasping for breath while the environment are been polluted day after day as the populace took alternative energy sources such as coal burning, 'wood for fuel' and unwholesome 'sound- fume' pollution rending Nigeria urban area as the populace sought energy alternative from individual electricity Generator ('I pass my neighbour'- An handy generator of maximum 980walts). The consequence of this is negative impact on human's health, environmental degradation which adverse effect is not far from global warming and flood in an unusual manner. Another Africa nation- Cameron has 187,000mw renewable energy potential from hydro alone but lives on just 4885mw only which most are consumable energy (thermal). In the northern Nigeria, Mabila plateau has the potential of generating at least 2700mw and over 300,000mw renewable energy potentials abound in Nigeria untapped and while demand for electricity within her territory fall short of supply (Obadote, 2009; Owolabi, 2010; Sambo, A.S 2008).

In the work of Iwayemi (2010), it was unfolded that energy potential in Nigeria comprises 35billion barrel of crude oil; 185 trillion cubic feet of Natural gas and at least 14,750mw hydro potential while solar energy was estimated to be 7.0kwper ha per day and energy from wind of about 150,000 terra joule per annum. In spite of this huge potential, larger percentage of Nigeria populace are experiencing blackout and many industries are folding up while long line are seen in petroleum filling station, forest reserve have been encroached upon for domestic energy need; all leading to high cost of living and unemployment which impact has led to alarming social vices-crime, prostitution and bad expression of action within the society (Dauda, 2014; Tar, 2014; Egunjobi and Alabi, 2007).

Without iota of doubt, small and medium industries dies prematurely without political will or succor on board to arrest the menace. The consequent is lost of industrial housing facilities. Sambo (2008) averred that prior to 1999; the Nigeria power sector had not witness substantial investment in infrastructural development. During that period, new energy plants were not constructed and the existing ones were not properly maintained, bringing the power sector to a deplorable state. In 2001, energy generation went down from the installed capacity of about 5,600MW to an average of about 1,750MW while load

demand is 6,000MW. The distribution line suffers and equipment breakdown due to low supply. For clarity, the article has been subdivided into five parts-following the introduction is the theoretical framework; literature review; body of study and conclusion.

Theoretical Framework

Housing being a component of the entire universe with energy required for its existence either in production process or after delivery sustainability / comfort. This is a system that makes living habitable. Thus, from the systemic theory philosophy, parts or components of any element perhaps of different attribute networks functions together either mechanically or electronically to achieve a desirable output through complimentary role from all the parts irrespective of the size or weight. Therefore, the design and implementation of good housing design / policy determines the energy generated or conserved. In view of this, housing as a system encompassing the floor, wall, roofing membrane, services and infrastructural element is design such that 'room(s)' is / are built for energy efficiency techniques from conception to design through construction such that cost of energy consumption would be is minimized and energy bill is ameliorated in the long run.

Literature Review

Sequel to global clamoring for sustainable shelter and energy, the need to plan and ensure optimum use of resources is very paramount. Effective implementation of good housing design has a way of ensuring that energy consumption is economically managed in a long term. Housing as analyzed in Agbola and Kazeem (2007) ranges from physical structure in a neighborhood, the facilities, plot layout, services and socio-cultural values attached to land. The process of producing housing was further said to include building materials, labour, finance, management, market, legislations, infrastructure and services. From the production of Housing, Agbola and Kazeem (2007) asserted that energy is required to drive some of these elements of production into fruitfulness. Therefore, efficient energy is required to cut cost billed on household. Thus, efficient energy in housing as expressed by on-line information of South Australia government- is a building with incorporation of environmental impact assessment and adoption of principles which economically leads to mitigation of heating and cooling bills at all climatic seasons of the year in compliance with Development Act 1993 of The Australia.

In Germany, a concept aimed at designing a house with sustainable and efficient energy were conceived via a discussion between two scholars-Professors Bo Adamson and Wolfgang of Sweden and Germany respectively and the ends product is Passivhaus- a house which is capable of reducing energy require for cooling in summer and heating at winter. The output of the idea gave birth to a house that operates on ultra-low energy buildings. These require just a little energy for space heating and cooling thus reducing household cost on energy consumption in a country where energy per capita is 759w (Gröndahl and Gate, 2010; CIA 2008 and Wikipedia, 2012). Other countries in Europe-Switzerland, Sweden and Demark has gone into research to have similar system such as

MINERGIE buildings designed for public buildings, offices, schools, supermarket and residential apartment to cut household cost on electricity. Kenya-a third world nation, saw the need to plan and manage energy thus drawn a 'Vision 2030' targeted at meeting her energy deficiency while other developing countries are also in the race of meeting their energy consumption- all are trying to find possible means of cutting cost and ensuring sustainability. In furtherance to the above, the author deems it fit to have though few but comprehensive review on what constitute housing-the definition, housing design and energy; types of energy generated from housing design across America, Europe, Asia and some Africa countries. Also, the issue of safety: the gains gotten and potential in effective energy management. It is imperative that scholars view on housing, housing design and energy management is examined. In the light of this, I suggest we discuss it under the following subtitle.

What is Housing

Housing as earlier referred, is a multi-dimensional bundle of services, contradictions and paradoxes. It has exogenous variables acting in support and against it validity. It is the largest industry virtually everywhere in the macrocosm yet one of the most backward in terms of capitalization and amount of serial production. It goes beyond a shelter that shield one from the harshness of weather elements (rain, sun, cold etc.) but it serves as an economic good, symbol of status, most valuable asset, security for loan, surety for suspect on judiciary process and the best physical and historical evidence of civilization (Agbola, 2009, Olatubara 2007, The Punch, 2012). Housing is important and indispensable to every individual and it is a means usually backed up with human interest either pecuniary or in kinds.

The United Nation 1948 declaration on human right article 25 emphasized the right to housing as part of the economic, social and cultural right of human. It is the foundation upon which decent living is based. The right as contained in article 31 of the European Social Charter also stated that housing should be standard and accessible; the homelessness should be reduced and the prices of housing should be made accessible to the poor who are without resources (UNCHS, 1999).

> *"Olatubara (2007) categorized housing types under structural design; tenure; quality and quantity; density; ownership; building materials and specialty. Under the structural design of housing, Brazilian types- of housing is the type of houses that is been referred to as 'face me: I face you' in Nigeria. Other structural types of housing include- Bungalow, Duplex, Flats, Manson, castles, town houses and compound."*

The bone of contention here is how these housing types have been managed or maneuver to reduce the energy consumption rate as well as aid generation of sustainable energy to the benefit of humanities. Sulab Technology demonstration of electricity generation from fecal waste in Indonesia, Afghanistan, India and some pacific countries was possible as a result of adoption of space standard either traditionally or by the state legislation. This made it easier for centralization of fecal collected within the neighbourhood, digested and process for energy generation (UN, 2008).

Housing Design and Energy

In this era of sustainability, it is of optimum important that the design of housing meet the call for sustainability. Design here means a plan for the arrangement of land use for accommodation which is graphically represented on two dimensional plane and further translated to land inform of structural component comprising-floor, wall, roof, social amenities and infrastructural services in addendum to it habitability while having sustainability attribute ((Binuyo, 2011). Sustainability under this write-up is designing housing in a manner that energy required for cooling or heating at all season of the year is such that bill paid for related services for cooling or heating activities is mitigated (South Australia, 2010). The South Australia 'Act' for clarity is of the view that-any building development that does not incorporate positive environmental impact statement and capable in energy bill reduction is not approved as sustainable thus; any housing design subject to approval must conform to be sustainable provision. Also, United State Environmental Protection viewed sustainable energy as green-energy that does not have negative impact on the environment: such energy include biomass energy, energy from wave, wind, solar, biogas and small hydro electricity generator.

Tester (2010) sees efficiency energy as -Dynamic harmony between equitable availability of energy-intensive goods and services to all people and the preservation of the earth for future generations. And, the solution will lie in finding sustainable energy sources and more efficient means of converting and utilizing energy. Also, Energy efficiency and renewable energy are seen as twin pillars of sustainable energy. Effectively, the provision of energy such that it meets the needs of the present without compromising the ability of future generations to meet their own needs (British, 2004). Thus, energy generation, efficiency & conservation source is paramount and there effective exploration for and through housing design would enhance a nation economy. Nigeria is so blessed with abundant energy sources such as winds, solar, hydro, thermal / gas and bio-waste (fecal and organic matter). Owolabi (2010) said Nigeria needs at least 90,000mw daily and consistently to attain the industrialize Nation we are aiming to be by 2020 against our less than 4,000mw being produce today (May 30, 2010) despite having more than 300,000mw potential energy from oil, gas, wind, water, ocean current, geo thermal, bio thermal and solar.

Housing Design, Energy and Space Standard in Damaturu Sahel

Having seen what Housing and Energy is all about, it is necessary we review the term-Space Standard (SS). Space Standard is one of the tools in physical planning of space that is used to guide development on, in and above the land (Obateru, 2007). It is one of the instruments used in development control in regulating activities on space to achieve conveniences, healthy and functional environment (neighbourhood, town, city etc.) where congestion are control and human inhabit with smiles beaming their faces. This tool (SS) however would stand a way of conserving money expended by householders for lighting during the bright day and cooling from natural air when adequately observed. Some of the SS tools comprise building lines, setback, air space and building height. Also, plot / building coverage, densities classification and land use analysis / approval. The Space Standard under consideration in this paper is limited to

Property coverage, Rooms standard, Building Orientation, Building lines, Height and Air space.

Property Coverage

This is refers to average space a building could covers on a buildable site either for residential, commercial, industrial or any land use whatsoever. Table below shows approved standard as contained in some town planning standard. Note: this is the minimum allowance development i.e. building structure should cover in relation to a buildable site.

Table 1: Property Coverage

Types of Density	Plot size (m)	Average Plot coverage (%)
Low Density	30m x 36m (1080sqm)	35
Medium Density	30m x 24m (720sqm)	40
High Density	30m x 18m (540sqm)	50

Source: Oyesiku, 1998

Survey carried out by the author on six neighborhood shows that resident around Government House Areas has an average of 90 percent development coverage per plot compliance. Sabon-Peggi- about 40 percent built-up per plot compliance; Obasanjo quarters 100 percent; Jerusalem 60 percent; 3-Bedroom in the neighborhood 100 percent compliance; Gonge- 10 percent level of compliance. The level of compliance in each of the neigbourhood surveyed shows that rate of Plot coverage per plot is proportional to energy need. Areas of high compliance require less energy for lighting in the day when compare relatively with areas of low compliance. Where space standard were observed, window function effectively as 3m air space afford lighting and occupier of such house need not to light or
electricity for lighting in the day.

Rooms Standard

This varies from a Clime to the other. It is also set base on occupier per room; function of the room-classroom; camping; residential; laboratory room; resuscitating room etc. whatever, the function, the design and construction should consider energy efficiency as well as other socio-economic satisfaction of the occupier. Room Standard set by planning authorities in Nigeria (Damaturu Local Planning Authorities) is 3.5m by 4.0m. The author discovered that where standard room is not maintained (physical size, orientation, window direction), occupier end up spending much money for lighting; cooling-mostly during hot weather; and also medical cost. On the medical aspect, heat related diseases are aggravated if a room falls below standard. This eventually can leads to economic dwindling as labour time hour would be affected.

Building Orientation and Construction

Building orientation simply refers to the direction a housing structure face. Research on Passivhaus buildings that is, Ultra-violet energy house and other effective energy house by German research team laid emphasis on orientation, climate and building component as requirement for energy saving house. The house must have northerly orientation to gain maximum advantage from solar energy, the building component such as the wall and the ceiling be insulated and the windows should be constructed such that proper ventilation is attained. 70% of houses in Damaturu are clustered in irregular manner as a result of this; exploration of solar energy by individual householder is slim as interference due to irregular congestion of housing stand a way of mitigating the energy direct from the sun.

Building Height

Building Height tool designate the maximum height a building should reach. This tool is usually applied to regulate development such that its height does not interfere with air activities like airplane take off and landing activities. This tool can also be adopted for aesthetic as well as energy conservation, generation and management. For, conservation, if height is regulated householder can maximize energy generation through photovatic (PV) solar panel. Obstruction would be mitigated as irregular rising of building height would be regulated and energy generated be optimized.

Setback

This tool simply mandated structural development (perimeter fence inclusive) to have some meters away from the road. This is to make provision for electricity line and other services pipeline (gas, sewers, communication cable etc.) whereby interruption during repairs or routine check is reduced. Also, setback in this article could serve as a tool of providing channel whereby collection of fecal waste 'energy base' from individual household to a central digester where the waste collected can be worked upon to generate biogas is network without hindrances. The gas generated then can be used for lighting, heating activities, powering of machine etc. Also, setback makes circulation of air flow easier. Less energy from 'wire' would be required if properly observed.

Table 2: Setbacks of Dwellings from Prop Lines and Height of Buildings

Class of Density	Min. Setback Front (m)	Building line Left(m)	Building line Right(m)	Height Right (m)
Low	7.5	4.5	4.5	4.5
Medium	6.0	3.0	3.0	3.0
High	4.5	2.0	2.0	2.0
Specially High	2.5	2.0	2.0	2.0

Source: Oyesiku, 1998

Housing Design Panacea to Energy Cost

The question is how does design influence energy efficiency. Nigeria dry land is attributed with high temperature at summer and low degree of temperature at winter. The orientation of building then must be within 20^0 east-west, avoid windows on these sides to prevent morning and afternoon sun heating up the house and light coloured roof should be adopted as this reflect the heat and make the building relatively cool thus reducing cost of artificial cooling via fan or air conditioning. The windows should be cross ventilated and avoid fixed glaze which may be capable of trapping breeze-preferable go for double leaf casement window and avoid narrow lobby that rays of light cannot be reflected.

Conclusion

The pattern of housing arrangement has effect on energy consumption. Overloading of electricity distribution can be influenced by irregular sitting of buildings and thus passing undue load on electricity distribution aid (transformer). Also, the poor housing design-orientation-wise; building material used, lack of appropriate observance of Space Standard can cumulate demand of energy a householder could have avoided. In the light of this, the author is of the opinion that housing design standard is popularized and professional be encouraged-patronized, and sought for professional advice on building as this in the long run would facilitate the reduction on compulsorily energy demand.

References

Agbola (2007), "Cultural and Theoretical Issues in Housing in Housing Development and Management." A Book of Readings edited by- Agbola, Tunde, Egunjobi 'Layi and Olatubara, C.O. Department of Urban and Regional Planning, University of Ibadan: Nigeria.

Binuyo, J. K (2011), "A Study of Mobile Toilet as a Sanitation Enterprise." Unpublished Master Degree Thesis, University of Ibadan, Department of Urban and Regional Planning, Ibadan, Nigeria.

British (2004), "Renewable Energy and Efficiency Partnership." Glossary of Terms in Sustainable Energy Regulation". http://www.reeep.org/file_upload/296_tmpphpXkSxyj.pdf. Retrieved September 15, 2012.

C.I.A, (2008), "The World Factbook". https://www.cia.gov/library/publications/the-world-factbook/rankorder/2042rank.html. Sighted September 15, 2010.

Gröndahl, M. & Gates, G. (2010), "The Secrets of a Passive House". New York Times Website, September 25, 2010 sighted in Wikipedia September 18, 2012.

Davidson, O., Chenene, M., Kituyi, E., Nkomo, J., Turner, C., & Sebitosi, B. (2006), "Sustainable Energy in Sub-Saharan Africa". Available: http://www.icsu-africa.org/Resource_centre/ICSU%20ROA%20-%20Report%20I%20-%20Sustainable%20Energy.pdf [March 7, 2007]. Sighted September 17, 2012.

Jacobson, M. Z. (2009), "Review of Solutions to Global Warming, air Pollution, and Energy Security". Energy and Environmental Science (Royal Society of Chemistry) 2: 148. doi:10.1039/b809990c. http://www.rsc.org/delivery/_ArticleLinking/DisplayHTMLArticleforfree.cfm?JournalCode=EE&Year=2009&ManuscriptID=b809990c&Iss=Advance_Article. Retrieved 2008-12-21. Sighted September 17, 2012.

Obadote, (2009), "Energy Crisis in Nigeria: Technical Issues and Solutions". Power Sector Prayer Conference June 25-27, 2009. June 25 - 27, 2009

Olatubara (2007), "Fundamental of Housing in 'Housing Development and Management." A Book of Readings' Edited by- Agbola, Tunde; Egunjobi 'Layi and Olatubara, C.O. Department of Urban and Regional Planning, University of Ibadan: Nigeria.

Owolabi, O. (2010), "The Energy Problem in Nigeria." The Guardian, Sunday, 30 May 2010 sighted on www.theguardiannewpaper.com 14 September 2012 around 12 a.m.

Oyesiku, K. (1998), "Modern Urban and Regional Planning: Law and Administration in Nigeria."

Sambo A. S. (2008) "Matching Electricity Supply with Demand in Nigeria". International Association for Energy Economics publication fourth quarter, 2008.

South Australia Government Development Act (1993, 2010). Sighted on 14 September, 2012

Tester, J. W. (2010), "The Twin Pillars of Sustainable Energy: Synergies between Energy Efficiency and Renewable Energy Technology and Policy". Aceee.org. Archived from The Original on May 5, 2008.

UNCHS (1999), "Habitat Debate" Volume 5 No. 3

Zeller, Jr., T. (2010), "Beyond Fossil Fuels: Can We Build in a Brighter Shade of Green?" New York Times, September 26, 2010, p.BU1.