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The Economic set back Caused by Energy Poverty in Africa (What is the Alternative Solution for a Better Future)

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Abstract—*Change your Energy you will change your life ,depending on the consumption of Energy that you made as individuals or as societies. Scientists have tried to make it a priority to the decision Makers and stake holders by answering this question "Energy Poverty . What is the Alternative Solutions for a better Future?"*

This is a research paper about the future of energy and sustainable economic growth of African economy. Even without a deep analysis of the energy industry, most people fundamentally understand that our current energy system is ultimately unsustainable and that renewable energy (including solar energy) will be an inevitable part of our common future. Global economic, environmental, and social pressures are driving our species and our economies to change how we harness vital energy, and these pressures will intensify as we approach the middle of the twenty-first century and expand to an estimated population of ten billion inhabitants on the planet.

This paper will answer some of these research questions: How much energy do we consume internationally; to what extent does poor use of energy affect economic development as a result of global warming; what are the alternative sources of renewable energy we can rely on in the near future hear in Africa?

The methods used in collecting data for this research are secondary in nature. Data were collected from books, journal, newspapers, magazines and Internet with all sources cited. Finally, it was recommended among others that policy makers should consider the possibility of gradually diversifying their sources of energy from fossils to renewable energy I.e by harnessing their abundant solar and wind energy and also convert waste to energy.

1. INTRODUCTION

The 24 industrialized member countries in the Organisation for Economic Co-operation and Development (OECD) accounted for 72% of world oil demand. The relatively new producer group, Organisation of Petroleum Exporting Countries (OPEC), produced 50% of the world's oil. In 1974, when OAPEC (Organisation for Arab Petroleum Exporting Countries) implemented an embargo cutting oil supplies to major consumer countries, the International Energy Agency (IEA) was born.

It's a known fact that developed countries always think of building a better future for the next generations , by keeping a sustainable sources of energy for them to continue their life, because the sources of energy that we know now is expected finish in less than 200 years from now. Therefore it is better for us to think of how we can find an agency born very soon to tackle this challenge (the poverty of energy).

Many of the greatest hurdles we will face in the next fifty years will be a direct result of how we currently and eventually decide to procure the energy necessary to sustain our lives and our standard of living. Human-induced climate change, resource wars over energy supplies, and cycles of deforestation, famine, and poverty that result from our insatiable appetite for energy are not new problems. Humans have grappled with these problems for centuries. The difference today is that these problems have accelerated in scale and potential repercussions to global proportions.

Inevitably, the threats that our relationship to energy creates will be mitigated when motivation and opportunity collide. This could happen when businesses and government compensate for the risks and costs of our current energy system with effective foresight and coordinated plan- ning or, alternatively, when we are forced to change in response to a 1970s-style energy crisis. Whatever the catalyst, the industrialized and developing nations of the world will eventually address these issues by using energy more efficiently and by developing and deploying local, sustainable, renewable energy sources.

1.2 The Concept of Energy Poverty

To outline the concept we must put it in two broad terms:

1. Lack of access to modern energy services by households" These services are defined as household access to electricity and clean cooking facilities (e.g. fuels and stoves that do not cause air pollution in houses).

2. Lack of adequate, accessible and affordable energy to promote economic growth and satisfy basic human need. This can be seen as lack of energy for commercial and industrial production that will boost the economy and improve the general standard of living.

According to these definitions it is apparently clear that we have a problem caused by energy poverty which is the subject of this research. This problem basically affect the economy of all developed and devolving countries and therefore need a serious move from various government, private individuals and scientist to salvage our precarious situation of energy poverty most especially in Africa.

2. LITERATURE REVIEW

Hundreds of millions of people have attained modern energy access over the last two decades, especially in China and India. Rapid economic development in several developing countries, increasing urbanisation and ongoing energy access programmes have been important factors in this achievement. Despite this, in a world where the total population grows persistently, in 2010, nearly 1.3 billion people did not have access to electricity; though this is close to one-fifth of the global population. Twice as many, around 2.6 billion people, relied on the traditional use of biomass for cooking (Table 1.0).

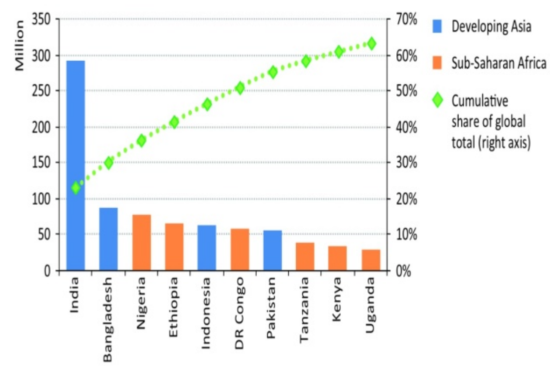
Table 1: Shows people without access to modern energy services by region 2010, (million)

	Without access to electricity		Traditional use of biomass for cooking*	
	Population	Share of population	Population	Share of population
Developing countries	1 265	24%	2 588	49%
Africa	590	57%	698	68%
DR of Congo	58	85%	63	93%
Ethiopia	65	77%	82	96%
Kenya	33	82%	33	80%
Nigeria	79	50%	117	74%
Tanzania	38	85%	42	94%
Uganda	29	92%	31	96%
Other sub-Saharan Africa	286	66%	328	75%
North Africa	1	1%	2	1%
Developing Asia	628	18%	1 814	51%
Bangladesh	88	54%	149	91%
China	4	0%	387	29%
India	293	25%	772	66%
Indonesia	63	27%	128	55%
Pakistan	56	33%	111	64%
Philippines	16	17%	47	50%
Vietnam	2	2%	49	56%
Rest of developing Asia	106	34%	171	54%
Latin America	29	6%	65	14%
Middle East	18	9%	10	5%
World**	1 267	19%	2 588	38%

* IEA and World Health Organization databases. ** Includes OECD countries and Eastern Europe/Eurasia.

Developing Asia and sub-Saharan Africa account, together, for more than 95% of those without modern energy access. Across developing countries, the average electrification rate is 76%, increasing to around 92% in urban areas but only around 64% in rural areas. More than eight out of ten people without modern energy access live in rural areas, an important factor when seeking to identify the most appropriate solutions.

There are nearly 630 million people in developing Asia and nearly 590 million people in sub-Saharan Africa who lack access to electricity. Just ten countries – four in Asia and six in Africa – collectively account for nearly two-thirds of those deprived of electricity (Fig. 1.0). While India has the largest population without electricity access, it has actually been a driving force in improving the trend in South Asia over the last decade, reducing the number of people without access to electricity by around 285 million. Large variations across the country persist, however: Goa and Himachal Pradesh, for example, report electricity use by around 97% of households, compared to only 16% in Bihar (Government of India, 2012). Other countries in developing Asia that report an improvement in the latest data include Indonesia, Myanmar, Nepal, Bangladesh and Pakistan. In sub-Saharan Africa, improvements in electricity access are reported in Ethiopia, Angola, Ivory Coast and Senegal, among others. Those countries with the lowest rate of electrification tend to be in sub-Saharan Africa.



Source: World Energy Outlook 2012

Fig. 1: Countries with the largest population without access to electricity

2.1 Africa Resource Rich but Poor in modern Energy

Africa is a continent full of energy resources, but it harvests only a little of these for its domestic use. North and West Africa have substantial oil and gas resources, while new exploration efforts have found significant resources also in East Africa; and South Africa is one of the world's largest suppliers of coal. Renewable energy resources are also abundant, with large hydropower potential in Central and East Africa, large geothermal energy potential in East Africa and favourable conditions for wind energy in North Africa, the Horn of Africa and South Africa. Solar energy potential is large across the continent and modern forms of biomass could also play a greater role in some areas. Despite this wealth of resources, Africa consumed less than one- quarter of the global average in modern energy per capita in 2011 while, at the same time, exporting more than half of the fossil fuels that it produced.

Africa's revenues from net energy exports are projected to increase from almost $280 billion per year to $415 billion in 2030. It was estimated that achieving modern energy for all in Africa by 2030 would require investments of around $20 billion per year, or 5.5% of energy export revenues over the period. Over the projection period, Nigeria is projected to generate $105 billion per year in oil and gas revenues on average, while universal access to electricity and clean cooking facilities there would require investment of around $1 billion per year. In the case of Angola, the country would need to invest, on average, only 0.5% of its projected energy-export revenues in modern energy access in order to achieve universal access by 2030. For Mozambique, the story is of future potential, with the exploitation of new natural gas discoveries offering the opportunity to boost significantly efforts to provide modern energy access.

2.2 Access to clean cooking facilities 11

According to World Energy Outlook 2012 the number of people without clean cooking facilities is projected to be around 2.6 billion in 2030 – more than 30% of the global population at that time. China achieves the single biggest improvement, with almost 150 million fewer people lacking access to clean cooking facilities by 2030, mainly as a result of economic growth, urbanisation and deliberate policy intervention, such as action to expand natural gas networks. Over the *Outlook* period, they project that, on average, around $635 million per year will be invested in clean cooking facilities. Despite this effort, population growth limits the global achievement only to ensuring that there is no significant worsening of the situation between now and 2030. The regional picture shows that developing Asia is projected to see a large reduction in the number of people without clean cooking facilities by 2030 – around 175 million. China and, to a lesser extent, India account for most of the net improvement, but India still has nearly 30% of the global population without clean cooking facilities in 2030. The story is grim in sub-Saharan Africa, where their projections reveal a worsening situation, with the number of people without clean cooking facilities increasing by more than one-quarter, reaching around 880 million in 2030

3. RESEARCH METHODOLOGY

3.1 Defining modern energy access

There is no universally-agreed and universally-adopted definition of modern energy access. For example, the UN Secretary General's Advisory Group on Energy and Climate (AGECC) defines energy access as access "to a basic minimum threshold of modern energy services for both consumption and productive uses. Access to these modern energy services must be reliable and affordable, sustainable and where feasible, from low-GHG- emitting energy sources". GIZ recommends an orientation to specific service indicators for lighting, communication and food preparation and, for instance, for electricity access defines five service levels, corresponding to a certain package and kWh per capita consumption.

For our model, we define modern energy access as "a household having reliable and affordable access to clean cooking facilities and to a minimum level of electricity consumption which is increasing over time". By defining access to modern energy services at the household level, it is recognised that some other categories are excluded, such as electricity access to businesses and public buildings that are crucial to economic and social development, i.e. schools and hospitals.

Access to electricity involves more than a first supply to the household; our definition of access also involves consumption of a specified minimum level of electricity, varying based on whether the household is in a rural or an urban area, which increases over time. The initial threshold level of electricity consumption for a rural household is assumed to be 250 kilowatt-hours (kWh) per year and for an urban household it is 500 kWh per year. The higher consumption assumed in urban areas reflects specific urban consumption patterns. Both are calculated based on an assumption of five people per household. In rural areas, this level of consumption could, for example, provide for the use of a floor fan, a mobile telephone and two compact fluorescent light bulbs for about five hours per day. In urban areas, consumption might also include an efficient refrigerator, a second mobile telephone per household and another appliance, such as a small television or a computer. However, we recognise that different levels are sometimes adopted in other published analysis. Sanchez, for example, assumes 120 kWh per person (600 kWh per household, assuming five people per household).

Our definition of energy access also includes provision of cooking facilities which can be used without harm to the health of those in the household and which are more environmentally sustainable and energy efficient than the average solid biomass cookstove currently used in developing countries. This definition refers primarily to improved biomass cookstoves, liquefied petroleum gas (LPG) cookstoves and renewables-based cookstoves (biogas, solar) that have considerably lower emissions and higher efficiencies than traditional three-stone fires.

Our definition is intended to be supportive of the objective to conduct forward-looking projections, but data availability means that it is not viable to apply it to our estimates of the number of people that do not currently have access to modern energy services. This definition cannot be applied to the measurement of actual data simply because the level of data required does not exist in a large number of cases. As a result, our energy access databases focus on a simpler binary measure of those that do not have access to electricity and those that rely on the traditional use of solid biomass for cooking. This is disaggregated (either with data or estimation) between those in urban and rural areas within a given country. This research is far from optimal but is driven by severe data limitations.

The number of people relying on the traditional use of solid biomass for cooking is used as a proxy for measuring those not having access to clean cooking facilities (again, due to data constraints). The traditional use of solid biomass refers to the use of solid biomass with basic technologies, such as three-stone fires, traditional mud stoves or metal, cement and pottery or brick stoves, with no operating chimneys or hoods. As a consequence of the pollutants emitted by these inefficient devices, pollution levels inside households cooking with biomass are often many times higher than typical outdoor levels, leading to about 4.3 million premature death each year according to the World Health Organization.[4]

3.2 Databases

3.2.1 Electricity access

The general paucity of data on electricity access means that it must be gathered through a combination of sources, including: IEA energy statistics; a network of contacts spanning governments, multilateral development banks and country-level representatives of various international organisations; and, other publicly available statistics, including US Agency for International Development (USAID) supported DHS survey data, the World Bank's Living Standards Measurement Surveys (LSMS), the UN Economic Commission for Latin America and the Caribbean's (ECLAC) statistical publications, and data from national statistics agencies. In the small number of cases where no data could be provided through these channels other sources were used.

For many countries, data on the urban and rural breakdown was collected, but if not available an estimate was made on the basis of pre-existing data or a comparison to the average correlation between urban and national electrification rates. To estimate the number of people without access, population data comes from OECD statistics in conjunction with the United Nations Population Division reports World Urbanization Prospects: the 2011 Revision Population Database, and World Population Prospects: the 2012 Revision. Electricity access data is adjusted to be consistent with demographic patterns of urban and rural population. Due to differences in definitions and methodology from different sources, data quality may vary from country to country. Where country data appeared contradictory, outdated or unreliable, the IEA Secretariat made estimates based on cross-country comparisons and earlier surveys.

3.2.2 Clean cooking access

Our database on the traditional use of solid biomass for cooking mainly makes use of the World Energy outlook Reports, World Health Organization's (WHO) Global Health Observatory estimates of reliance on solid fuels. In line with the level of data available from most sources, it focuses on the population where solid fuels are the primary fuel for cooking. Where World Energy outlook make an adjustment to subtract coal use from WHO totals, based on the most recent national data. Precise numbers on stove type or quality and on secondary sources of fuel for cooking are not available for most countries. Once again, we combine this data with population estimates from OECD statistics in conjunction with the United Nations Population Division reports World Urbanization Prospects: the 2011 Revision Population Database, and World Population Prospects: the 2012 Revision. Reliance on solid biomass data was adjusted to be consistent with demographic patterns of urban and rural population.

In order to provide an outlook for electricity access in the next decades, a model able to generate projections of electrification rates by region has been developed. The projections are based on an econometric panel model that regresses historic electrification rates of different countries over many variables, to test their level of significance. Variables that were determined statistically significant and consequently included in the equations are:

- GDP per capita
- Population growth
- Urbanisation level
- Fuel prices
- Electricity consumption per capita
- Electrification programmes
- Technological advances

3.2.3 Power generation

To estimate the need for additional generation needed, we match the additional demand from people getting access to the existing residential demand, total electricity generation and generation capacity. We take into account losses and own electricity use by the power generation sector for grid-supply. For urban-area electricity demand, the less costly choice is electricity grid extension, thus the model assumes that generation in urban areas is made entirely through grid options. In rural areas, options to increase electrification include extension of existing grids, creation of mini-grids and off-grid solutions. That part of the rural area – around one-third of total rural demand – closest to urban areas and/or likely to become more densely populated by 2040 is also projected to be supplied through the grid, as this will be the most economic option. The remaining rural generation is divided between mini-grids and off-grid generation, including oil, solar PV, mini-hydro, wind and bioenergy in the mix.

3.2.4. Investments

The investments in generating assets are a straightforward calculation multiplying the capital cost ($/kW) for each generating technology by the corresponding capacity additions for each modelled region/country. The investment costs represent overnight costs for all technologies. The model also calculates investment in new transmission and distribution networks.

3.3.1 Additional population with clean cooking access

Historical trends show that economic development and income growth do not automatically lead to a decrease in the traditional use of solid biomass. In practice, there are numerous considerations, besides income, that are in play, particularly the relative prices and availability of the various alternatives. Reliance on solid biomass rates of different countries is econometrically projected using many variables to assess their level of significance. Variables that were determined statistically significant and consequently included in the equations are:

- Population growth
- Urbanisation level
- Availability and price of fuelwood and charcoal
- Availability and cost of alternative clean fuels and cookstoves
- Technological advances
- Clean cooking programmes

3.3.2.Clean cooking options

LPG stoves are judged to be more likely to penetrate in urban zones, where infrastructure, distribution and fuel costs can benefit from economies of scale and consumers have a relatively higher ability to pay. Thus LPG stoves are assumed to provide clean cooking services for all urban zones still relying on the traditional use of biomass but for only 30% of rural households. The large majority of rural households are assumed to be provided with improved biomass cookstoves, and the remaining with biogas digesters or solar cookstoves. Those global targets are then reflected in regional allocations of the various options regarding the most likely technology solution in each region, given resource availability and government policies and measures.

3.3.2.1 Investments

Table 2: Technology characteristics of different cooking options

	Investment cost ($)	Efficiency	Daily hours for cooking	Consumption per household (toe/year)
Traditional cookstoves				
Charcoal	3 - 6	20%	2 - 4	0.5 - 1.9
Fuelwood, straw	0 - 2	11%	2 - 4	1.0 - 3.7
Alternative cookstoves				
Kerosene	30	45%	1 - 3	0.1 - 0.2
LPG	60	55%	1 - 3	0.08 - 0.15
Electricity	300	75%	1.2 - 2.4	0.07 - 0.13
Biogas digester	600-1 500	65%		
Improved cookstoves:				
Charcoal	14	26%	1.5 - 3	0.4 - 1.5
Fuelwood	15	25%	1.9 - 3.8	0.5 - 1.6

Note: toe = tonnes of oil equivalent.

Sources: Jeuland and Pattanaya, (2012); Department of Energy at the Politecnico di Milano; IEA analysis.

Investment costs are calculated based on the unit cost of the different devices. Infrastructure, distribution and fuel costs are not included in the investment costs. Only the cost of the first stove and half of the cost of the second stove is included in our investment projections. This is intended to reflect a path towards such investment becoming self-sustaining.

4. RENEWABLE ENERGY RESOURCES IN SUDAN

To inter the field of Renewable Energy Resources in Sudan let us start with this argument about the energy in general :-

1. How much energy is available in the immediate environment , what is the resource ?
2. For what purposes can this energy be used , what is the end use?
3. 3.What is the environmental impact of the technology . is it sustainable?
4. What is the cost of the energy , is it cost effective?

Depending on the last four point we can outline the sources , the usage , the sustainability , the cost and as We say the planning to our position in the next ten years by choosing what is suitable to lead the Enovation. we can sort out the renewable as :-

- Solar Photovoltaic generation : is power caused by electromagnetic radiation separating positive and negative charge carriers in absorbing material , it is very wide available in Sudan because of our sunny climate , the usage depending on the cost of establishment and its not available to the ordinary people in Sudan but it can be used in services facilities such as hospitals .
- Hydro-power : the generation of shaft power from falling water. The power is then used for direct mechanical purposes or, more frequently, for generating electricity. Other sources of water power are waves , it is also available because of existing of River Nile and Red Sea , we need to develop the usage of wave power in port Sudan for example to solve the problem of energy in eastern cities and establish a development project there .
- Wind power : is The extraction of power from the wind with modern turbines and energy conversion systems , it is widely available because of current flow of wind particularly in the west , north and east of the country , it can be used for the services facilities and factories and developing project in the rural areas.
- Geothermal energy : Heat passes out through the solid submarine and land surface mostly by conduction – geothermal heat – and occasionally by active convective currents of molten magma or heated water.
- Biomass and biofuels : The initial energy of the biomass-oxygen system is captured from solar radiation in photosynthesis (the use of industrial biofuels, when linked carefully to natural ecological cycles, may be non-polluting and sustainable. Such systems are called agro-

industries) , the sources of bio mass and bio fuel is widely distributed in Sudan because of agricultural nature of the population, so the using of this power can solve the problem of deforestation , desertification related with uncontrolled cutting to the trees to have an energy for dailypractice or to produce charcoal for commercial purpose, by destroying the local environment and causing a health problem to the rural population .

Table 3: People (In Millions) relying on Traditional Biomass

Countries	2004	2015	2030
Sub Saharan Africa	575	627	720
North Africa	4	5	5
India	740	777	782
China	480	453	394
Indonesia	156	171	180
Rest of Africa	489	521	561
Brazil	23	26	27
Rest of Latin America	60	60	58
TOTAL	2528	2640	

4.1 Waste to Energy Access to the Sustainable Renewable Energy

According to the increasing in number of the population depending on the natural resource of biomass as source of energy in the rural area , causing a negative impact to surrounding environment Recycling of Waste in to Briquetting Carbonized Bagasse is a solution for many environmental and health problems caused from the use of fuel wood for cooking. It has a serious health implications especially on women and children who are disproportionately exposed to the smoke. The solution is to recycle the agricultural waste to use it as a source of renewable energy. By 2030 biomass will be an outstanding solution for individual heating, dominated by wood chips, wood logs and pellets in rural areas. This projection however can only be achieved if conscious effort is made in commercializing the use of biomass as heating energy source.

5. CONCLUSION

African leaders should pay more attention to the energy demand of their various countries as such will contribute positively to their countries' economic growth which will tend to result in higher standard of living as well as higher life expectancy.

REFERENCES

[1] International Energy Agency :Worldwide engagement for sustainable energy strategies : 2013 .

[2] International Energy Agency - affordable clean energy for all : 2013.

[3] THE OPEC FUND FOR INTERNATIONAL DEVELOPMENT (OFID) OFID and Energy Poverty Challenges : 2010 .

[4] World Economic Forum, "Energy Poverty Action," 2010 .

[5] United Nations Environment Programme - Regional Office of North America : Global Trends In Sustainable Energy Investment 2010 : From http://www.rona.unep.org 2013 .

[6] Sources: OPEC Data; BP Statistical Review of World Energy 2009; World Development Indicators (WDI) database, World Bank 2009

[7] RENEWABLE ENERGY POLICY NETWORK FOR THE 21st CENTURY : RENEWABLES 2014 GLOBAL STATUS REPORT :2014.

[8] John Twidell and Tony Weir : Renewable Energy Resources :Taylor & Francis e-Library, London : 2006.

[9] The same source : John Twidell and Tony Weir : Renewable Energy Resources :Taylor & Francis e-Library, London : 2006.

[10] Source: International Energy Agency, 2006

[11] ENHANCING THE PROPERTIES OF COAL BRIQUETTE USING SPEAR GRASS (IMPERATA CYLINDRICA) AND ELEPHANT GRASS (PENNISETUM PURPUREUM) : BY OGBU IKECHUKWU MARTIN DEPARTMENT OF PURE AND INDUSTRIAL CHEMISTRY FACULTY OF PHYSICAL SCIENCES, NNAMDI AZIKIWE UNIVERSITY, AWKA. SEPTEMBER, 2010

[12] Cioabl_, A.E. and Ionel, I. (2011). Biomass waste as a renewable source of biogas production – experiments. In: Alternative Fuel, M. Maximino (Ed.). Published by In Tech.

[13] World Energy Outlook websites www.worldenergyoutlook.org