Attaining Self-Reliant and Sustainable Energy in Sub-Saharan Africa: Challenges and Opportunities [1]

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ABSTRACT

The demand for Energy in most Sub-Saharan African (SSA) countries has become unimaginable despite its high potentials for natural and renewable resources. The deficit has impeded the regions' economic growth and sustainability. The continent of Africa is endowed with abundant energy resources much of which have not been exploited as a result of numerous challenges. This study reviewed the Challenges and Opportunities facing Sub-Saharan Africa in attaining self-reliant and sustainable energy. The method adopted is a desk research method. It is a literature based conceptual work. The opportunities associated with renewable energy resources includes: Energy Security, Energy Access, Social and Economic development, Climate Change Mitigation, and reduction of environmental and health impacts while the challenges include Market failures, lack of information, access to raw materials for future renewable resource deployment, and our daily carbon footprint. The study focused on solar renewable energy resources. Result shows that SSA region can attain self reliant and sustainable energy through the development of renewable energy especially the solar energy. It concluded that attaining self-reliance in energy with highly energy use appliances can be achieved. It therefore recommended that SSA governments should as a matter of urgency rise up and engage in advocacy programmes to create awareness on the enormous potentials of renewable energy and energy saving appliances in the sub-region.

Keywords: Attaining, Self-reliant, Sustainable energy, Sub-Saharan Africa, Opportunities and Challenges

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INTRODUCTION

Energy is fundamental to human welfare. Energy is the property of a system that enables it to do work. That is, work cannot be done without having energy; energy is expended to do work (Babatunde, 2007). In other words, the amount of work done is determined by the amount of energy put in. When the supply of energy is exhausted in a system, the system stops working. For example, when fuel is exhausted in a vehicle, the vehicle stops moving.

Sub-Saharan Africa (SSA) is a region with abundant sources of energy resources such as, wind power, hydro power, bio-mass and solar power but it energy need is on the increase and her increasing population is not balanced by adequate energy development programme. The present system of sole dependence on hydro-power sources for energy supply is inadequate, as this is controlled by factors such as the seasonality in the levels of water at the different hydro-power stations (Karekezi, &Kithyoma, 2002).

Access to clean modern energy services is an enormous challenge facing the Sub-Saharan Africa (SSA) because energy is fundamental for socioeconomic development and poverty eradication. Today, 60% to 70% of the Nigerian population does not have access to electricity (Oyedepo, 2012) the same goes to other countries with the region. The current challenges facing SSA include lack of access to energy. For instance, electricity access in 47 countries that are in sub-Saharan Africa (SSA), with the exception of South Africa, do not generation energy capacity equal to Argentina energy alone (US EIA, 2011). Furthermore, a quarter of its generation capacity lacks adequate maintenance and has outdated equipment (US EIA, 2011). Evidently, the cost of generating electricity in SSA adds up to a high US$0.18/kWh when compared to South Asia-US$0.04/kWh and East Asia-US$0.07/kWh (AfDB, 2010). So, SSA possess only 24% share towards electricity access which is the lowest globally (Eberhard et al., 2008).

It is of different kinds and forms with broad division under the renewable and non-renewable energy sources. The non-renewable sources have been the most used and produce harmful emissions, thereby making it environmentally unfriendly (Nguimfack-Ndongmo, et al 2019).

There is no doubt that the present energy crisis afflicting SSA will persist unless the government diversifies the energy sources in domestic, commercial, and industrial sectors and adopts new available technologies to reduce energy wastages and to save cost.

This paper looks on ways of attaining self-reliant and sustainable energy in Sub-Saharan Africa: Challenges and Opportunities. The main questions posed by this study are: What are the challenges of sustainable energy provision in SSA? What are the opportunities for sustainable energy in SSA? Therefore, the associated objectives of this study are: to analyse the challenges of sustainable energy provision in SSA and to determine the opportunities in sustainable energy in SSA.

LITERATURE REVIEW

Renewable Energies

The SAA has enormous potential for all types of renewable energy, including hydropower, solar, wind, geothermal and biomass. The term "Renewable energy" according to Ajaelu, H. C. and Okereke R. A (2020) covers all forms of energy generated from natural resources such as sunlight, wind, water (or hydro power), tide, geothermal heat, biomas and biofuels. They are derived from natural processes that are constantly replenished and each of them has characteristics that determine where and how they are used. Several renewable energy projects in many countries have shown clearly that renewable energy can directly contribute to poverty alleviation by providing a substantial amount of energy needed for creating businesses and employment especially in rural communities that have not yet been connected (Okereke et al, 2020).

Solar energy can be seen as the anchor behind various forms of renewable energy. It anchors hydro power where the hydrological cycle is being controlled by the sun as well as Wind Power where the movement of air is due to the heating effect of the sun on the atmosphere. In general, heat, kinetic energy, electrical energy and chemical energy can be provided via solar energy conversion (Nguimfack-Ndongmo, et al 2019). In theory, solar energy can be perceived as an ideal energy source, because it is free and virtually limitless. However, the technological barriers with regards to its collection, distribution and storage are great. Solar energy forms the basis or acts as the source of all other forms of energy on earth. Hence with the increase in intensity of solar radiation reaching the earth, it is paramount that this invaluable resource be put into adequate and efficient use in various areas of life. Solar energy utilization takes its root in the early ages when solar energy (sun) was used as a clock, as a compass, for preservation of food etc. In this modern age we have simply improved upon the findings of the old to get greater value, efficiency and time saving. To this end solar energy is ever growing and ever expanding in its utilization (Oyedepo, 2012).

Hydroelectricity

It is the most developed form of electrical energy in Africa. However, a large proportion of the hydroelectric potential (12% of the world's potential) remains under-exploited and is mainly located in Central Africa, particularly in Congo-Kinshasa and Cameroon. An important potential also exists along the Nile, Guinea-Conakry and Mozambique. The exploitation of this hydraulic potential would provide clean energy and low unit costs, but it nevertheless requires expensive installations (Bob-Dubley and Spencer, 2018). Within the framework of the emergency plan for the development of the hydropower sector, the Cameroon government has launched a program to build new hydroelectric power dams and stations (Esty, & Winston, 2006) which will be fully operational by 2020 and will contribute to reduce the national energy deficit.

Solar Energy

Africa benefits from a high level of solar radiation, especially within the Saharan region. The use of solar energy for the production of electricity can be done in two ways; solar thermal for dryers, cookers, heaters, production of electricity via hot steam etc and solar photovoltaic for decentralized energy production. The latter solution requires the use of equipments that are still very expensive for some regions of Africa. A current project aims at setting up PV installations in the Sahara could eventually cover 10 to 15% of Europe's electricity needs (Nguimfack-Ndongmo, et al 2019).

Wind Energy

Many African regions (mountainous or coastal) benefit from a good exposure to winds but Africa ranks last in terms of wind power production. This type of energy represents only 0.4% of the world's wind energy production and is produced mainly by three countries: Tunisia, "Cap Vert" and South Africa (Gsanger, and Pitteloud, 2012).

Geothermal Energy and Biomass

A geothermal potential has been found in the Rift Valley. It is exploited by Kenya for electricity production (125 MW power plant). The consumption of biomass, mainly firewood and charcoal, is high in Africa: African consumption of charcoal accounts for more than half the world production and about 60% of energy consumption in sub-Saharan Africa (Nguimfack-Ndongmo, et al 2019). This massive consumption of biomass has so many negative effects such as: harvesting of timber (which is time-consuming and mostly carried out by women), health problems related to the inhalation of smoke in houses. Nevertheless, there are new ways of producing and consuming wood (improved firewood cookers), as well as energy crops that are being realized in order to reconcile the use of biomass and the protection of ecological balances (Tam et al, 2019).

MATERIAL AND METHOD

This is a literature-based study whose data came mainly from secondary sources. Textbooks, journals, magazines, as well as other publications from the internet formed the sources of the ideals, arguments and concepts used in this paper.

The researcher reviewed literature materials on attaining self-reliant and sustainable energy in Sub-Saharan Africa (SSA).The study focuses on exploration of solar renewable energy as a way for SSA to attain self-reliant and sustainable energy.

The authors reviewed literature on solar energy potentials and issues surrounding their successful deployment and proceeded to develop a detailed road map of how these potentials can be harnessed for sustainable energy generation in SSA. Numerous advantages that should serve as a stimulant to policy makers to both adopt and implement the plan were also explored.

Data Analysis

The information from the various sources of data were thoroughly studied and analyzed. Analysis was done with the objectives of the study at the background alongside the literature review.

RESULTS AND DISCUSSIONS

Energy in Sub Saharan Africa

World Bank (2007) records that the percentage of SSA population with access to electricity is attached at approximately 44.6%, which suggests that a lot still needs to be done for the people of Africa. It is observed that Africa's energy sector is subject by fossil fuels, hydro, nuclear and biomass which cannot meet the energy demand in the region especially in this technology advance century (see table 1). Therefore, it calls for the need to look at other sources of energy supply. Tables 2 and 3 show the renewable energy potential of African countries. Additionally, various types of renewable energy have been identified to exist and can be tapped by SSA countries, these include geothermal, hydropower, wind energy, solar and bioenergy. It must be pointed out that some countries have already taken the lead in adopting these forms of renewable energy (see table 4).

Table 1: Summary of Africa's Total Energy Production in Kiloton of Oil Equivalent (Ktoe) from 2000–2015.

Category	2000	2005	2010	2015
Production of electricity from biofuels and waste	135	163	187	349
Production of electricity from fossil fuels	29,921	37,321	44,975	62,212
Production of nuclear electricity	1,119	971	1,101	1,221
Production of hydro electricity	6,607	8,107	9,738	12,495
Production of geothermal electricity	37	77	126	329
Production of electricity from solar, wind, etc.	20	128	326	1,086

Source: Adams, and Asante, (2019).

Table 2: Renewable energy capacity (MW) in leading African countries

Country	**2009 (MW)**	**2018 (MW)**
Congo DR	2514	2750
Egypt	3354	4813
Ethiopia	1443	4326
Ghana	1187	1659
Morocco	1520	3263
Mozambique	2198	2235
Nigeria	2087	2143
Sudan	1681	2136
Zambia	1723	2446

Source: Adams, and Asante, (2019).

Table 3: Renewable energy production (Giga Watts per hour) in leading Africa countries

Country	**2009 (GWh)**	**2017 (GWh)**
Angola	3308	7897
Cameroon	4017	5106
Congo DR	7940	9287
Cote D'Ivoire	2132	2054
Egypt	15942	15957
Ethiopia	3593	12585
Ghana	6893	5672
Kenya	3923	8407
Malawi	1813	1915
Morocco	2976	4706
Mozambique	16994	14127
Namibia	1405	1526
Nigeria	7454	7803
South Africa	1648	10453
Sudan	3379	9484
Tanzania	2738	2611
Uganda	1458	3745
Zambia	10604	12537

Country	2009 (GWh)	2017 (GWh)
Zimbabwe	5517	4214

Source: Adams, and Asante, (2019) and International Renewable Energy Agency Report 2015

Table 4: Types of renewable energy capacity and production in Africa

Renewable energy	Leading African countries with capacity (MW)	Leading African countries in production (GWh)
Geothermal	Ethiopia, Kenya	Kenya
Hydropower	Congo DR, Egypt, Ethiopia, Ghana, Morocco, Mozambique, Nigeria, South Africa, Sudan, Zambia	Angola, Cameroon, Congo DR, Cote D'Ivoire, Egypt, Ethiopia, Ghana, Kenya, Malawi, Morocco, Mozambique, Namibia, Nigeria, South Africa, Sudan, Tanzania, Uganda, Zambia, Zimbabwe.
Wind	Egypt, Ethiopia, Morocco, South Africa, Tunisia.	Egypt, Ethiopia, Morocco, South Africa, Tunisia.
Solar	Algeria, Egypt, Morocco, Reunion, South Africa	Algeria, Egypt, Morocco, Reunion, South Africa
Bioenergy	Eswatini, Ethiopia, South Africa, Sudan, Zimbabwe	Angola, Egypt, Eswatini, Kenya, Mauritius, Reunion, South Africa, Sudan, Tanzania, Uganda, Zimbabwe

Source: Adams, and Asante, (2019).

CHALLENGES AND OPPORTUNITIES FACING SUB-SAHARAN AFRICA IN ATTAINING SELF-RELIANT AND SUSTAINABLE ENERGY IN THE REGION

Solar energy utilization for generating electricity no doubt has several advantages which include: low operational and maintenance cost, a very high meantime between failures of about 20-30 years, noiseless and no moving parts during operation, availability of PV panels in different sizes or modules over a wide range of power rating, perceived environmental friendly nature with respect to release of greenhouse gases, global warming, ozone layer depletion, etc. According to Tam et al (2019), one of several reasons that lead to global warming appears to be due to the large contribution of greenhouse gas (GHG) emissions. Organisation for Economic Co-operation and Development (OECD) contributes about 39% of global GHG emissions. However several issues arise in generating electricity from solar energy. These issues include:

Long Energy Pay-Back Time

Sherwani et al. (2010) carried out a review of the life cycle assessment of solar PV based electricity generation systems. According to their findings, the variation in the energy pay-back time (EPBT) and greenhouse gas (GHG) emissions have been dependent upon many factors, such as the type of solar cell, solar panel orientation and angle, irradiation of the location, difference installation (integrated or non-integrated systems as well as facade, flat roof and solar roof tiles), efficiency of the Balance of system (BOS) components, size (capacity) of the system, lifetime of the system and the electricity mix of that particular country and year of study. The main issue that arises from this is that EPBT influences the decision of investors to invest in electrical energy generation using PV panels. If investors perceive the EPBT in solar PV based electricity generation systems to be too long, they may decide to seek alternative investments which will hinder the growth of the Solar PV electricity generation Industry. According to Krishnaraj et al (2019), green building advancements include an integrated approach for maintainable objectives and to improve productivity, such green building's expense may be higher but the payback period can be reduced very much through reduced operation and energy costs. It is therefore necessary that the energy pay-back time of solar PV based electricity generation systems be reduced considerable through continuous improvements in designs to facilitate production of PV cells that are cheaper and yet have higher efficiencies (Okereke et al, 2020).

High Up Frontal Capital Cost

Another major downside of solar energy utilization in generating electricity is the high up frontal capital cost compared to its conventional energy alternatives (Chigbo, 2010). The general perception is that this technology is not yet mature, hence it is only suited for particular markets and even then will require heavy subsidy to make it viable. This is quite inaccurate to some degree as many countries such as Germany, the United States and China have succeeded with their solar energy utilization plans and are already enjoying the numerous dividends (Tyagi et al., 2013). Solar voltages have been powering space modules since the beginning of space programmes and talking about the cost, the high up frontal capital cost can be handled by letting Giant companies and Governments play a part in the programme by bringing in the much needed up front capital and recouping their investment over time.

Ignorance of the Benefits of the Technology

Another serious setback to the solar energy program is ignorance of the benefits of this technology. Awareness of the opportunities offered by solar energy and its technology is low among members of the public and private sector stakeholders. This lack of information and awareness creates a market distortion that results in higher risk perception for potential renewable energy projects.

According to Kok et al. (2011), energy conservation interventions have frequently failed because they often did not take the full range of significant influences on human behaviour, into account. There is therefore a need for dissemination of information on solar energy resource availability, benefits and opportunities to the general public in order to raise public awareness and generate activities in the sector. Kenya has taken giant steps in the number of solar power systems installed per capital (but not the number of watts added). More than 30,000 very small solar panels are sold in Kenya annually, as more Kenyans adopt solar power every year than they make connections to local grid.

Requirement of Large Expanse of Land.

Another major issue in the use of solar PV panels is the large expanse of land required for their installation. Clearly, moving to solar energy as a major energy producer would mean an enormous reallocation of land and resource use. However with the continuous improvement in PV efficiencies, the required space per Kwh of electricity generated will continue to be on the decrease.

Low efficiencies of PV panels

Table 5: PV panel materials and their efficiencies

PV panel material	Present Average Efficiency(%)	Remark
Monocrystalline Silicon Solar Cell	28	Available Commercially
Polycrystalline Solar Cell	19.8	Commercial efficiencies are about between 12 and 15%
GaAs Cells (often mixed with other metals as alloys)	40.7	Highest efficiency so far
Dye-sensitized and organic base cells	5.4	Lowest efficiency
Thin film technology	19.9	Available Commercially
Hot carrier solar cell	66	Has never been commercialised but remains an experimental technology due to lack of suitable material that can decrease carrier cooling rates

Source: Data extracted from the review carried out by (Tyagi et al, 2013 adopted from Nguimfack-Ndongmo, et al 2019).

Low efficiency of PV panels is another draw draw-back presently limiting the widespread diffusion and usage of PV cells in generating electricity. PV panel efficiencies must be increased to establish their acceptance in the energy market. Table 1 shows some materials used for making PV panels and their efficiencies. It can be seen from the table that GaAs cells which uses multi-junction cells have the highest efficiencies so far. It is believed that exploiting the multi junction technology will provide the future PV panels with higher efficiencies. PV panel efficiencies and output power decreases due to increase in temperatures hence the need to provide cooling at high illumination conditions. Dust and humidity also reduce the efficiencies of solar PV cells to lower values.

Solar Irradiation

Solar irradiation which varies throughout the entire day and affects the efficiency and output of PV cells is another issue being considered in using solar cells. Increase in solar irradiance increases the PV module efficiency because the high number of photons hitting the module increases and many electron-hole pairs are formed which will produce more current. During the night, solar irradiation is zero hence PV cells will have zero output at night. A simple way to solve this problem is to incorporate another renewable energy source such as wind energy with the solar PV modules so that they will deliver the required power at night. Electricity storage in batteries is also useful to make electrical energy available during these periods when solar irradiation is low or not available.

Environmental Pollution

Although solar PV cells are generally acclaimed to be environment friendly, their by-products during the manufacturing process and waste after their useful life can also constitute environmental hazards. Raw materials for making solar PV cells are obtained through mining operations which may cause danger to miners. In addition, mining machines involve usage of fossil fuels such as petrol and diesel which also cause environmental pollution through emission of hazardous gases and heavy metal from the mines. As more PV cells are manufactured and installed, the environmental pollution which results through their manufacturing process and disposal after their useful life will also be on the increase.

	Challenges	Opportunities
Financing and investments	• High costs inherent to the energy sector • Limited access to funding • Creditworthy utilities/ Insufficient cost recovery • Elastic demand/Affordability • Foreign exchange risk	• Investing in cost reducing technology • Collaborative Investing/Engaging local investors • Alternative financing sources -such as bonds • Increasing partial risk guarantees • Enhanced refinancing opportunities
Policy, regulatory and institutional frameworks	• Lack of competition to networks • One-off PPAs • Inefficient tendering processes • Breach of contracts • Vested interests in established business models • Inability to raise tariffs to cover costs	• Utility unbundling to open up competition • Setting multi-year tariffs - with adjustment clauses • Clear renewable energy targets • Aligning with climate and sustainability targets • Clear and transparent procurement process
Information and technical capacity	• Limited technological capabilities • Weak judicial systems • Non-harmonised regional regulatory frameworks • Bureaucratic procedures • Uneven policies in different countries	• Streamlining public agencies • Education on risk mitigation • Research and development • Strengthening regional capacity and co-operation

Table 6. Challenges and opportunities of Africa's energy sector

CONCLUSION AND RECOMMENDATIONS

The energy generated in SSA is grossly inadequate, hence the need to improve structures on ground, and also introduce alternative energy technologies (i.e. renewables) to complement current government efforts to provide sustainable energy for the citizens (Federal Ministry of Environment, 2013). It then results to insufficient and epileptic electricity supply, a situation which has led to individuals, corporate and government organizations making alternative arrangements to provide electric power for their installations using various generators with a wide range of power capacity. No doubt, this has increased the cost of production and by direct consequence supports inflation and a lower standard of living of Citizens. The additional cost these installed generators bring with their usage is that of environmental degradation which has become a major concern in our world today. Thinking "renewables" is therefore a general approach that has been identified to fill in this energy shortage without degrading our environment.

Sub-Sahara Africa is well-endowed with high levels of renewable energy resources. The existing level of utilization of renewable energy, using modern technologies, is low, it is for this reason that all stakeholders in the energy sector should as a matter of urgency rise up and engage in advocacy programmes to create awareness on the enormous potential of the technology. African youths should adopt Renewable Energy production as a vocation in the future. While there is need for governments and wealthy individuals to fund pilot projects, fresh graduates wishing to establish renewable energy technology business should be provided soft loans, a mechanism therefore needs to be established for this. Well managed alternative energy sources can turn around the economy of this great Africa continent (Ajaelu, H. C. and Okereke, R. A, 2020).

In order to solve the energy poverty in the region, the region has to work as a team to intensify the further implementation of renewable energy and energy efficiency programs. The government of it country in the region has to make sure this support the region team task on renewable energy as observed in quite a number of successful countries promoting renewable energy, such as Germany, Denmark, and Japan, a strong and long-term commitment from the government is crucial in implementing any kind of policies which will lead to the development of renewable energies, in particular, and a sustainable development, in general.

In addition to these, the existing research and development centers and technology development institutions should be adequately strengthened to support the shift towards an increased use of renewable energy. The preparation of standards and codes of practices, maintenance manuals, life cycle costing, and cost-benefit analysis tools should be undertaken on urgent priority. Human resource development, critical knowledge, and knowhow transfer should be the focus for project development, project management, monitoring, and evaluation. As it is required to both develop newer technologies and maintain the existing ones on energy in the region (Abdullah Badawy Mohammed, 2019).

Government should refocus its efforts at developing the country's renewable energy potentials, to serve as an alternative source for increase in power generation. To achieve this, steps must be taken to attract the required capital investment in renewables. Government should guarantee returns on investment by putting in place tariffs that are cost-reflective.

Regional governments should create room for the mini-grid regulation as such avenues can help increase electricity generation through renewables. It is designed to provide off grid power to areas without distribution infrastructure. Also, regulatory, fiscal and legal incentives should be formulated and implemented. Such incentives should be designed to augment themselves. For example, the government's mini-grid regulation can enhance investment in renewables if import tariffs on renewable technology can be waived. This will help reduce costs, which is a major constraint on development of renewable energy.

Finally, African governments should endeavour to: ensure quick approval of the energy and renewable energy policy documents in those countries where existing, set up Renewable Energy Fund for Research and Development (R&D); facilitate partnerships between the local energy institutions and International Donor Agencies, International Finance Institutions and Development

Partners, etc for R&D. Micro-finance institutions and facilities should be put in place to empower rural and peri-urban dwellers, especially women, to establish small scale energy service companies based on renewable energy resources and technologies; Intensive public awareness activities should be embarked upon to educate rural and peri-urban communities on energy efficient methods through NGOs, community leaders and the mass media. The challenges and opportunities of African energy sector are summarized in Table 6 above.

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ABBREVIATIONS

AfDB	African development bank – An international Bank for African countries that aims to encourage sustainable economic development and social progress thus contributing to poverty reduction.
AFREC	African energy commission – This body was set up by the Organization of African Unity (OAU) now known as AU to map out energy development policies, strategies and plans based on sub-regional, regional and continental development priorities and their implementation.
AREF	African renewable energy fund – This is a fund established to support small to medium scale independent power producers (IPPs) across sub-Saharan Africa. It is managed by Berkeley Energy, an experienced renewable energy fund manager active in Asian and African emerging markets.
AU	African Union – An intergovernmental organization with African Countries as members. It was formed in 2002 for mutual cooperation to replace the defunct Organization of African Unity.
EREC	European renewable energy council – This was created in the year 2000, and it is the umbrella organization of the major European renewable energy industry, trade and research associations active in the field of photovoltaics, small hydropower, solar thermal, geothermal, etc.
GWh	Giga Watts per hour – A unit of energy representing one billion watt hours and equivalent to one million kilowatts hour. It is used as a measure of the output of large electricity power stations.
IEA	International Energy Agency – An intergovernmental organization that ensures reliable, affordable and clean energy for its 30 member countries and beyond. Their mission is focused on 4 main areas: energy security, economic development, environmental awareness and engagement worldwide.
InfraCo Africa	InfraCo Africa is part of the multilateral Private Infrastructure Development Group (PIDG). InfraCo Africa seeks to alleviate poverty by mobilizing private investment into infrastructure projects in sub-Saharan Africa's poorest countries to the highest standards.
IPCC	Intergovernmental Panel on Climate Change – This is the UN body for assessing the science related to climate change. It provides regular assessments of the scientific basis of climate change, its impacts and future risk and options for adaptation and mitigation.
IRENA	International Renewable Energy Agency – An intergovernmental organization that supports countries in their transition to a sustainable energy and serves as the principal platform for international co-operation, a center of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy.

Ktoe	Kiloton of Oil Equivalent – This is a unit to measure the amount of Energy released by burning a thousand tonnes of crude oil.
MSF	Multiple streams framework – A theory developed by John Kingdon to explain agenda setting in the policy making process.
MW	Mega Watt – This is a unit of power equal to one million watts, especially as a measure of the output of a power station.
PIGD	Private Infrastructure Development Group – It encourages and mobilizes private investment in infrastructure in the frontier markets of sub-Saharan Africa, south and south-east Asia, to help promote economic development and combat poverty. Since 2002, PIDG has supported 154 infrastructure projects to financial close and provided 222 million people with access to new or improved infrastructure.
REEEP	Renewable energy and energy efficiency partnership – A body that develops innovations, efficient financing mechanisms to advance market readiness for clean energy services in low and middle-income countries.
SE4ALL	Sustainable energy for all – An independent not for profit international organization with headquarters in Vienna, Austria. Some of its priority areas include electricity for all in Africa, energy for displaced people, energy and health, etc.
UNEP	United Nations Environment Programme – It is part of the UN system. It is the arm of the UN that takes charge of all environment-related issues.
UNFCCC	United Nations Framework Convention on Climate Change – It is part of the UN system, and established in 1992. It is tasked with supporting the global response to the threat of climate change.

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