

**Omnipresent Yet Elusive:
The Paradox of Why Solar Energy Is Not More Widely
Used in Africa**

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Abstract

Africa has many resources, but most are not accessible to everyone. Sunlight is one of the few resources that are available to everyone, and because Africa receives so much sunlight in a year, solar energy should be a prime target for investment. If Africa can adopt solar energy, it will alleviate many economic, social, and political problems for its people and the environment. Paradoxically, solar energy has not been widely exploited in Africa. This paper argues that solar energy proliferation has been challenged by the lack of supply and demand in solar energy caused by extreme poverty and the composition of the African society, hindrances which political instability has only exacerbated. By pointing out the causes of why solar energy usage cannot grow in Africa, the world can change its methods and target the real reasons that are obstructing solar energy expansion. Looking at success stories, such as the Grameen Bank program in Bangladesh, can also offer ideas for new initiatives. Hopefully shedding light on this riddle will make solar energy become a common source of energy in Africa and the world.

Omnipresent Yet Elusive: The Paradox of Why Solar Energy Is Not More Widely Used in Africa

Conflicts, diseases, and poverty ravage many parts of Africa, but one resource that Africa has in great abundance is sunlight. Africa receives about three hundred twenty-five sunny days a year, and it has three large deserts: the Sahara, Kalahari, and the Namib (Bin Talal Our Planet 11-13). Solar energy is so powerful that with the right technology, an area slightly smaller than Portugal can provide the same amount of energy as all of the world's power plants combined. One-kilometer square of the Sahara Desert receives solar energy equivalent to 1.5 billion barrels of oil each year (Sharife). Interestingly enough, the main sources of fuel for most Africans are biomasses-- such as wood, manure, and plant parts-- coal and oil, despite the abundance of potential solar energy. This research hopes to identify the reasons for this paradox in hopes that by doing so, targeted actions can be taken to make solar energy more proliferative in Africa.

Advantages of Solar Energy

Currently, the two most commonly used forms of

solar energy technology are the photovoltaic (PV) system and the concentrated solar power (CSP) system. PV panels directly convert solar energy into electricity, and they can be installed as a home energy system or on individual appliances, such as the solar calculator (Eaton). The CSP system is better for producing energy on a large-scale by using mirrors or other reflective surfaces to focus direct sunlight onto a surface, which then heats up water to make steam. The steam then turns turbines to generate electricity like a conventional electricity generator (Desertec-Africa, Harcourt, Walt). Traditional CSP systems produce electricity at a plant that is then transferred through cables to households, but now there are also CSP systems for individual homes.

Solar energy will allow people to enjoy the convenience of reliable electricity and can bring many positive changes to their lifestyle, health, economic situation, and the environment. People can use this energy to illuminate their homes with bright lights instead of the shadowy light of kerosene lamps. Solar electric stoves and water pumps mean women will not have to spend hours gathering wood, animal dung, or water (Sachs 19), not to mention other electrical indulgences such as a television or radio. Children can study for longer hours at night with ease, which aids their learning effort. Families have more useful hours in a day instead of having to sleep at sundown. Their homes will also not be filled with the stench of kerosene, burning wood, or animal dung, meaning that the interiors of their homes will be much more comfortable to live in, not to mention that hospitals can run more efficiently and more reliably.

In regards to health, people can benefit from improved eyesight because they will no longer have to strain their eyes in the dim glow of kerosene lamps. As there will be no need for burning kerosene or biomass, the indoor pollution problem will greatly improve, decreasing the occurrences of health conditions that result from inhaling toxic fumes (Sachs 19). Electrified water pumps can draw water from farther sources that are cleaner for drinking, which will be highly beneficial to the average household and hospitals. Electricity also means that medicines and vaccines can be refrigerated and kept for a longer time, decreasing occurrences of spoiled medications.

Families will be able to save a lot of money with solar energy. After the initial set-up of the solar energy system, there are virtually no expenses other than more fees except for the occasional maintenance fee. Electricity will also bring more light into homes, which means that people can be productive for more hours in the day. It is estimated that families spend twenty percent of their income on fuel alone (Browne). Thus, now, people can save money by not having to buy kerosene for fuel. The increase in productiv-

ity and money saved will give them the ability to buy more commodities and have more comforts of living.

Solar energy cuts out the need for conventional energy sources, which are non-sustainable and detrimental to the environment. In Africa, the burning of oil, natural gas, coal, and wood to make electricity releases many toxic substances into the atmosphere (ENDA-TW 37), which harms people's health and the environment. Deforestation has become a major problem in recent years as families often burn wood for fuel. Many people use battery-operated appliances because they do not have electricity, but old batteries are environmentally hazardous when they are not discarded properly. With solar energy, people can cut down usage of environmentally unsafe energy sources.

The international community has recognized solar energy's many potential benefits and has tried to propagate solar energy technology in Africa for decades. For example, in the late 1980's to early 1990's, the German technical cooperation, GTZ, created the Special Energy Program (SEP) in order to bring PV refrigeration, lighting, water pumps, and micro-hydraulic generating stations to many countries, including Mali, Burkina Faso, Guinea Conakry, Senegal, and Niger (ENDA-TW 58-61). Efforts from international organizations in Africa have had mixed results. The fact that solar energy technology has been around for decades but is still not widely used is not because of technological hindrances. The problem lies with structural problems that are long embedded in society.

Obstacles to Obtaining Solar Energy

Africa seems to be the perfect place to begin the trend of adopting solar energy. However, "Africa has a lot of sunlight, but other factors are not present to sustain this technology," said Vicente Yu, a program coordinator of South Centre. Sunlight alone is not enough to make solar energy the main energy source. Africa's solar energy market has many demand, supply, and political problems that make expansion of the market highly difficult.

Demand-Side Barriers

A major reason that is stopping solar energy from becoming more popular in Africa has to deal with a lack of demand from the people. One of the reasons why there is a lack of demand is because there is a lack of knowledge of the technology. Because of how separated the villages are, it is hard to distribute information to remote villages. It is also highly difficult for technology used in one village to travel the long distance and spread to other villages. The locations of the villages make publicity of new ideas in Africa challenging.

Some people do not have a use for solar energy. Many African farmers usually wake up at sunrise, work all day, and sleep at sunset. Their lives are synchronized with daylight hours, so they do not need to have electricity for light at night. Some people are so poor that they do not have any electrical appliances (ENDA-TW 8, Yu). Only seventy-four percent of children in Sub-Saharan Africa were enrolled in primary education in 2007 (Millennium Development Goals Report 2009 14-16). This means that many children still do not go to school, so they do not need a light to work late at night (Yu). These people have lived without electricity their entire lives, so they are used to being without electricity or do not need any electricity, even if electricity is handed to them.

There is also a lack of incentive to switch to a different source of energy. Some regions have free access to wood for fuel, and the availability of other fuel sources, especially free or cheap sources, divert people from wanting to switch to solar energy. One of the biggest problems, and one of the hardest issues to overcome, is the financial situation of a typical African household. In 2008, sixty four percent of employed people in Sub-Saharan Africa lived below \$1.25 a day (The Millennium Development Goals Report 2009 6-13). They cannot afford a small solar energy appliance that costs \$5, even if that price is very cheap. PV panels are expensive to produce (Desertec), so it is difficult to lower the price of the technology so that they are more affordable to the African household. Because they make so little, African families have to spend money on more pressing concerns such as food or clothing. Internal conflicts cause high instability and insecurity and make it even harder for them to improve their economic situation (Zurcher). If their lives are not even secure, they have much more urgent matters to worry about than how they will get energy. Although credit systems are beginning to multiply in Africa, there are still no credit systems in many places (Archer). Many times, the poorest of the poor who need help the most are not helped because their substandard situations fall outside of the helpable credit realm. Therefore, many people do not have the desire or the power to switch to a new energy source.

There is also a lack of after sales services. The remoteness of some areas leads to very regular technology breakdowns because of poor maintenance and poor surveillance of products (ENDA-TW 41). Solar technology, unfortunately, is not manufactured in Africa (SEFA). Experts are usually internationals, so they are not there to teach locals how to take care of the systems. After the technology breaks down, there is a lack of trained technicians who can fix the device, making it highly risky for buyers. If there is a trained technician, it is not possible to find replacement parts to fix the technology because all the parts were

imported. All of these problems with the PV solar system raise the risk of investing in one, so it is difficult for a poor, African family to entrust so much money in this system.

Supply-Side Barriers

There are few solar energy technology suppliers in Africa because it is difficult to enter the market and succeed in it. Most of solar technology equipments have to be imported, so to be a solar energy supplier in Africa, the entrepreneur must pay a high start-up fee for the initial investment in equipments (ENDA-TW 114). Many companies specialize in full-house solar panel systems, but only a few homes have the correct structure to install such a system, so demand is small. The remote locations of some of these homes make it difficult for solar energy suppliers to install their products (ENDA-TW 8). The bulk of these companies' profit comes from large, public projects, but these big projects occur only once in a while, and many companies fail to survive in the interim between projects. Many entrepreneurs who try to invest in solar energy in Africa go bankrupt because the existing market is too small to be sustainable. Countries in Africa also have a lot of political issues. The civil wars and instability in many countries raise the risk of doing business, further discouraging private investment (Archer, Johnson-Sirleaf and Oppenheimer, Zurcher). Political instability can also disrupt the trade with foreign markets, and because most solar energy technology is imported, instability can greatly disrupt the importation chain (ENDA-TW 33). The high barriers to enter the market, along with the high failure rate, discourage many entrepreneurs who are possibly interested in solar energy.

The majority of solar energy projects of the past have been sponsored by international organizations or bodies. International organizations or bodies have sponsored the majority of solar energy projects of the past. These projects had to comply with donors' wants, but sometimes the projects are not in the community's best interest. Often sometimes technology caused dissonance in the local culture. Because these projects had international origins, the local population did not truly adopt them to be their own (Anonymous). After the international organizations left, the projects broke down because of lack of further supervision. These past failed efforts have shifted people's attention away from more investments in solar energy.

Political Barriers

Most African states are highly unstable and suffer from political conflicts. The progress that a state has made is soon destroyed by conflicts in the region (Fall), so Africa remains an underdeveloped continent with slow economic growth

(Yu). Governments feel they have more urgent issues than energy, such as political problems or the financial crisis, so they do not focus their efforts on energy. Setting up a state-wide energy system is also extremely complicated. Besides installing the large energy generating plant, states will also have to consider the cost of connecting the many homes to the electric grid. Many nations are used to receiving foreign aid and are still relying on it (Zurcher). They do not invest in their own countries with their own funds but wait for donors to give them money for projects (Global Green New Deal 1). States that tried in the past to invest in renewable energy technology made calculation errors. They usually devoted about eighty percent of their entire fund to the implementation of the project (ENDA-TW), with very little fund left for maintenance fee. After several years, the projects broke down but were not repaired, so the technology was simply abandoned. Governments have made many blunders in the past that have made solar energy seem like an undesirable investment.

Learning from Past Mistakes

The methods to introduce solar energy into African communities have not worked in the past, even though there have been efforts for the last four decades. At the moment, solar energy is only used sparsely across the continent, and most of its consumption is focused in South Africa. In order to make solar energy more widely used in Africa, it must be introduced in such a way that the local community will adopt it and sustain it. NGO's and other energy organizations should continue to give presentations and educate people on the importance and benefit of solar energy, but they should also target villages that are hard to reach and let them know about the latest solar energy technology that they can afford. Communities can also encourage clean energy consumption from a young age by teaching it in schools (Haddad Our Planet 14-16) so that even children know the benefits of solar energy. Children should also be encouraged to teach their parents about what they have learned in class so that their parents will want to invest in solar energy.

It is necessary to make technology available that makes solar energy beneficial. People should also make available technology that would make solar energy beneficial. In order to make an intervention effective, people must consider what else the local population needs (Yu). Organizations can sell small scale solar appliances to families for a cheaper price than market value as an incentive for these families to invest in solar energy. They can also sell PV power lights, rechargers, batteries, radios, and other small electrical appliances that can be used with solar energy.

The companies, organizations, or governmental

agencies that are in charge of selling solar energy packages should make return visits to their past customers to make assessments of how the locals have used the products (ENDA-TW 47). They should also teach the local community how to take care of their products after they have gotten the chance to use it for some time. In line with encouraging the local community to adopt a technology, people should also train the local people to fix the products so that they can independently sustain it once the intervening organization has left. An added benefit of training the local community to repair the systems themselves is it would give the more skillful repairers of the community a new skill, and these people can choose to capitalize off of this. Organizations should especially target women because they have very little skill, but when they are empowered, they can greatly influence their community (Fall, Zurcher). "One of the easiest ways to develop a country is to empower the women," said Roger Zurcher from Food for the Hungry. Then women can become entrepreneurs too, bettering their lives.

The local community can and should help itself. If people in that community are too poor to have credit, they can pool their money together so that they can have enough credit to borrow money (Zurcher). They can use this money to fund public projects such as installing a PV system for the community. NGOs interested in encouraging solar energy use should try working more with the local governments who are usually easier to access and less corrupt (Cadestin), so it is much easier to collaborate with them.

Bigger international organizations, such as the UNDP and UNEP, can help by working with the national government to encourage them to adopt solar energy. These large international organizations have more ability to sway national government decisions (UNEP 2008 Annual Report 46-50). One way is to make African governments see the value in renewable energy by showing them the unsustainable nature of their current consumption pattern. Africa should recognize that energy security is a priority, and that solar energy can be the solution.

African governments should encourage their people to use solar energy by helping them fund for the initial cost of purchase. Governments can cooperate with private banking companies to give the poorest families a loan to buy solar energy technology, or to devise an installment payment plan so that the cost of purchase is manageable. Governments can further help by subsidizing the purchase of renewable energy technology so that people can afford it. They can reward people for making energy efficient decisions, such as giving seeds or fertilizers to farmers if they buy a solar energy technology. Subsidies can also be given to solar energy companies so that they can sell their prod-

ucts for cheaper to customers, thereby making them more affordable.

Current Initiatives

Still, people have not given up on disseminating solar energy in Africa, and many organizations and groups are trying to find innovative ways to make solar energy work for Africa. African governments are increasingly working on smaller scales because these are easier to monitor, and these have become a more common scheme (Browne). ToughStuff is a social enterprise that is selling smaller solar energy packages so that they can be more affordable for the average household (ToughStuff). Vivian Alberts and his team from the University of Johannesburg are engineering solar panels that are 50% cheaper than current solar panels (Johanna Solar Technology, Sharife). Desertec is a company that is trying to gather political and financial support to build a huge CSP plant in the Saharan Desert that could provide energy to all of Europe and many areas of Africa (Desertec).

An initiative that deserves special attention for this area of study is the Grameen Bank's efficient energy model in Bangladesh. The Grameen Bank started out as a credit bank for very poor people who wanted to start a business, but it also wanted to bring electricity to the rural areas of Bangladesh. The first step was to build a rural network, so it worked with local and international engineering institutions to recruit and train engineers, who were then deployed throughout Bangladesh. These experts then trained local technicians and users on how to use the PV solar systems. It trained rural housewives to take care of the system. The Grameen Bank provided jobs to the local community, which gained it community support. Because the technicians were locals, this also allowed the bank to offer efficient, low-cost after sale services. The Bank created a scholarship program for schoolchildren and taught them about renewable energy technology. It then developed a suitable financial and technical package for rural people and made payments installment-based, making the initial payment as cheap as kerosene. The engineers make monthly visits to check on the system for 2-3 years after, then for a small fee thereafter. Over 205,000 homes across Bangladesh have installed PV solar systems. These systems can power lights and small-scale electronic appliances. Over 8,000 systems are installed per month, and demand is increasing exponentially. It has also distributed 20,000 improved cooking stoves and has a goal of distributing 1 million more stoves by 2010, covering 35,000 villages. 20,000 jobs have been created. It wants to create 100,000 jobs by 2015, mostly for women (Global Green New Deal 21, Barua Our Planet 24-25). This method has received great success and

is sustainable because it uses a commercial method with micro-finance, but succeeds in replacing kerosene lamps with PV electricity at the same time. More studies should be done on this model to see if its success can be replicated elsewhere.

Solar energy has many benefits, especially for an unstable continent such as Africa. If Africa is able to harness the power of the sun, solar energy when managed correctly can be a sustainable and lucrative trade that can bring prosperity to its people. Solar energy will be able to improve people's lifestyle, economic situation, health, and environment. However, Africa also has many problems that make solar energy difficult to have. The biggest problems are the configuration of the African society and widespread poverty, which lead to low demand and low supply of solar energy. Political problems also create undesirable conditions for solar energy to proliferate. In order for solar energy to be a successful energy source in Africa, there must be change from the governmental level and the household level. International organizations and entities can help Africa open up to solar energy, but their efforts should be to ultimately have Africans adopt solar energy on a voluntary basis for themselves. Solar energy in Africa is an abundant energy source that can bring energy to the entire world. Although the barriers to switching to solar energy are great, the benefits are even greater, so both African and non-African states should work together to make it a viable energy source.

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