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The Elusiveness of Light: The Difficulty With Harnessing the Omnipresent Solar Energy in Africa

Hai-Vu Phan
SIT Study Abroad

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The Difficulty with Harnessing the Omnipresent Solar Energy in Africa

By Hai-Vu Phan

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Academic Directors: Gyula Csurgai and Alexandre Lambert

Yale University
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Student Name: Hai-Vu Phan

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Abstract

The world is currently facing an energy crisis. Our dependency on oil and natural gas has led to many global problems, such as OPEC's oil hikes which have disrupted economies everywhere and caused oil dependent countries to suffer. Our huge consumption of oil has also led to the global warming catastrophe that we currently must combat. The world must find a new energy source soon, or more environmental, political, social, and economic problems will occur. Solar energy's potential has been recognized for many decades, and its abundant and limitless supply makes it the perfect new form of energy. Solar energy is especially plentiful in Africa where the sun shines all year round. Ironically, this seemingly cure-all solution has not yet been widely exploited in Africa. This situation seems illogical, and this paper strives to investigate the reasons why solar energy has not yet proliferated in Africa. If Africa can adopted solar energy, it will alleviate many economic, social, and political problems for its people and the environment. 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. Hopefully shedding light on this riddle will make solar energy become a common source of energy in Africa and the world.

Preface

I first became aware of how powerful energy can be in the global arena when I learned about the Russian-Ukraine energy crisis which caused almost all of Western Europe to be without electricity for several weeks in the dead of winter. This led me to choose the topic of energy security in the twenty-first century for my ISS paper. Solar energy seems to be an answer to energy security problems. It is limitless, powerful, environmentally safe, obtainable, and everyone has it so one nation cannot use it as political blackmail. Especially now with global warming such a big threat, the need to convert from non-renewable energy to renewable energy is even more urgent. Yet, astonishingly, nations are barely scraping the surface when it comes to solar energy research and investment. I wanted to find out why nations, especially those in Africa that have a lot of sunlight, have not tried to expand solar energy usage before, and this paper is the end result of my inquisitiveness.

Acknowledgements

I would like to sincerely thank Professor Csurgai and Professor Lambert for guiding me throughout the evolution of my ISP project. I came into this project with a very broad sense of what I wanted to research, and they helped me narrow down my topic by giving me ideas and contacts so that I can pinpoint exactly what I wanted to study. I would also like to recognize the support that my family and my Swiss family have given me by being my moral support and providing me with a warm environment where my thoughts can flourish. I would like to acknowledge the many people who were kind

enough to spare some time from their busy schedules to meet with me and impart on me some of their expertise. These people are: Colin Archer, Younis Ahmed, Etienne Cadestin, Roger Zurcher, Coumba Fall, Vicente Yu, Avani Dixit, Derek Christie, and an anonymous retiree from the ILO. Last, but not least, I want to thank my fellow SIT colleagues with whom I was able to discuss my preliminary ideas.

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"These countries do not have to become hydrocarbon based societies. They have the opportunity to skip from the 19th Century to the 21st Century."

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Solar Electric Light Fund, USA
UNCED 1992[1]

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The Barren Continent Full of Resources

The colonial period has left many residual effects in Africa that have crippled Africa's development. The Western states left a power vacuum in Africa after their departure because the indigenous population did not have experience in governing. Synthetic borders grouped several ethnic groups under the same political structure or split a nation between several states, resulting in political and social tension[2]. Instability and insecurity have seriously hindered development, and Africa is now home to many of the poorest of the poor in the world. Many people live for under $1 a day, and

[1] International Solar Energy Society. *Solar Energy Solutions for an Environmentally Sustainable World.* ISES. June 1992.

[2] Ahmed, Younis. Consultant, International Peace Bureau. *Personal Interview.* 21 October 2009.
Yu III, Vicente Paolo B. Programme Coordinator, Global Governance for Development Programme, South Centre. *Personal Interview.* 16 November 2009.

children die from hunger every day. Women can spend hours each day gathering water that might not even be clean. There are widespread diseases, such as malaria and AIDS, but there are not enough hospitals and clinics to take care of everyone[3]. In most countries, no more than twenty percent of the population has direct access to electricity[4].In rural areas, which are where the majority of Africans live, this number is about two percent of the population (Madamombe). New statistics on the worsening suffering in Africa blast across newspapers and headlines so frequently that people have become desensitized to its actual severity. Poverty in Africa is such an issue that the entire world has been trying to combat it for decades, but with little effect.

Paradoxically, Africa is actually a country rife with resources. The northern, southern, and western regions of Africa have large fossil fuel reserves. Nigeria and Libya are two of the leading oil exporters of the world [5]. Africa has a wealth of natural resources and minerals, along with large tracts of forests and land. It also has great coastlines suitable for harnessing wind and tide energy (Desertec-Africa[6]). Many rivers course through Africa, including the Nile, Congo, Niger, and Zambezi Rivers, and these

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[3] Sachs, Jeffrey. "The end of poverty: economic possibilities for our time." *European Journal of Dental Education.* The American Dental Education Association. Journal compilation. 2008 12 (Suppl. 1), 18

[4] Madamombe, Itai. "Solar Power: Cheap Energy Source for Africa." *Africa Renewal, Vol.20 # 3 (October 2006),* page 10. http://www.un.org/ecosocdev/geninfo/afrec/vol20no3/203-solar-power.html

[5] Rena, Ravinder. "Rich Countries and their Leverage on Africa." *Africa Economic Analysis.* 23 January 2008. http://www.africaeconomicanalysis.org/articles/gen/rich_countries.html

[6] Desertec-Africa is a branch of Desertec. Desertec is mostly concerned with bringing energy to Europe, while Desertec-Africa focuses on how this new energy system will be able to bring benefits to Africa.

can be employed to produce hydroelectricity. Africa has enough resources to fuel itself if only it would invest in the right industries. Unfortunately, the abundance of resources that Africa has is accessible to only a few people.

One resource that Africa has in great abundance is sunlight. Africa has three large deserts: the Sahara, Kalahari, and the Namib. Africa receives about three hundred twenty-five sunny days a year. Many parts of Africa get twelve hours of daylight a day for most of the year round (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 of all of the world's power plants combined. 0.3% of light falling on the Sahara and Middle Eastern deserts can meet all of Europe's energy needs (Walt). One hour of solar radiation is enough to power the world for a year. One kilometer square of the Sahara Desert receives solar energy equivalent to 1.5 billion barrels of oil each year (Sharife). It makes practical sense for Africa to capitalize on this copious and powerful resource.

Interestingly enough, solar energy is still not widely used in Africa. Only South Africa has invested in solar energy to an appreciable extent, while all other states have only worked with solar energy on a small scale. The main sources of fuel for most Africans are biomas-- such as wood, manure, and plant parts-- coal, and oil. A large majority of people still lives without electricity or proper lighting despite the abundance of potential solar energy. This circumstance is perplexing, and this paper will try to explore why this situation exists in Africa by looking at the many benefits of solar energy for Africa, why past efforts to promote solar energy have not worked, what can be done so that solar energy can become more utilized, and current efforts that try to sidestep these past blunders to make solar energy more widespread in Africa.

Solar Energy Systems

The two most widely used methods to harness solar energy are the photovoltaic (PV) system and the concentrated solar power (CSP) system. Both systems' technology and potential have been known and sparsely used for a long time. Most people are acquainted with the PV panels, which have been used with everyday household appliances, such as solar calculators, since the 1970's (Eaton). PV panels convert solar energy directly into energy. They can generate electricity even on cloudy days, which means that they make a reliable energy generating system. The problem with PV panels is that the excess energy that they create is difficult to store. Currently, the excess energy is stored in rechargeable batteries, sent through cables to be stored in energy plants, or used to pump water in a pumped-storage hydroelectricity procedure[7]. PV panels have made their way into people's everyday lives because they are very effective with small-scale appliances.

The CSP system is more complex and is better for generating electricity on a larger scale than the PV system. In a CSP system, mirrors or other reflective surfaces focus solar radiation 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). The electricity is usually generated at a plant and then transferred through cables to places that need energy. This system makes good use of existing expertise in electricity generation because it is not much different from existing generating methods that use oil and coal (Karekezi). CSP systems

[7] Pumped-storage hydroelectricity is when this excess energy is used to pump water from a low elevation reservoir to a high elevation reservoir. This water is later released into traditional hydro-power turbines to be converted into energy. (Karekezi)

must use direct normal radiation (DNI[8]) because only this energy is sufficiently high enough to heat water, so CSP systems work best in extremely sunny environments.

Not every African home receives electricity through electrical wires like people in the West do. Many developed countries and areas use a grid system to deliver electricity. A grid system is a network of cables that connects power plants to homes to deliver the electricity. In Africa, South Africa has the biggest percentage of its population connected to the grid system, with over eighty percent of its population reliant on electricity from the grid (Sharife). The grid system can easily accommodate the CSP method because CSPs can easily connect with the existing power grid. Urban areas of Africa usually have an electric grid. Most of African rural homes, however, are not built on an orderly plan. Some people live in huts or hovels that are difficult to reach. Bringing in cables and wires to connect these families to an electric grid is very difficult, so most families are not connected to the grid. PV systems work better in these unconnected areas because they can provide small amounts of energy for individual use and do not have to be connected to a grid.

Solar Energy Promotion Is Not a New Occurrence

Since the time that the PV system technology was applied to everyday appliances, people have been trying to expand its use. In the 1980's, PV appliances became very popular worldwide, leading to mass production. Prices for the PV system dropped significantly between 1980 and 1987 (ENDA-TW 141). Many PV systems were installed into television sets in the period 1978-1988 (ENDA-TW 87). The application of PV systems onto water pumps started in the 1970's (ENDA-TW 90-91). Most PV systems and

[8] Direct normal radiation (DNI)- radiation that is not reflected off of any surface, such as the ground, clouds, or atmospheric dust

their applications were already well established by the early 1990's, and they were usually used for telecommunications, lighting, refrigeration, water pumps, and power supply (ENDA-TW 140). Thus, people have tried to promote the use of PV solar energy for many decades all over the world.

The international community has made many efforts to bring solar energy to Africa. 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). The Danish International Development Agency (DANIDA) has been active in Mali and Niger since 1988, focusing mainly on installing solar equipments with the existing hydraulic system (ENDA-TW 63-64). Another notable program was the Regional Solar Programme (RSP), which was a collaboration effort between the European Economic Community and West African countries to increase the use of PV systems with water pumps, lighting system, vaccine storage, and battery rechargers. RSP's other purpose was to create jobs in the area (ENDA-TW 64-66). There has been many different solar energy projects from international organizations in Africa for some time, and their efforts have had mixed results.

The CSP system has also had a long history. Its technology has been used since the early 1980's. One of the most notable CSP plants is the one in the California Mojave Desert, which is a hybrid system incorporating both CSP and conventional forms of energy in order to make electricity. Now there are also micro CSPs which are easier to install and can produce enough electricity for a single home so it does not have to be

connected to a grid (Pottinger). Even rural homes can have a CSP system effectively installed.

The current market for solar energy is very diverse. There are many companies that offer services to all parts of Africa, even to remote regions. These companies can range from installing whole-house energy systems with solar panels, or to selling small appliances such as solar batteries, small-size solar panels, solar lights and lanterns, solar water heating systems, solar water pumps, and solar refrigerators (ENF). Most demands come from the telecommunications market, such as railway companies and the army, because the appliances in telecommunications are very simple (ENDA-TW 40). Solar energy in Africa today is usually used for lighting, audiovisual appliances, water pumping, refrigeration, stations and minipower networks, mills, and battery chargers.

Many Benefits of Solar Energy

Solar energy has many recognizable benefits. Especially for people in Africa where sunlight is abundant and free, solar energy is a great source of energy because it can bring unlimited electricity to every home. Current energy sources such as oil, coal, and kerosene are expensive and quickly depleting, so they cannot be a sustainable energy source for African people, most of whom are poor. People all over the world in general, and African people in particular, will need to quickly find another source of energy that is sustainable. If solar power can become more widespread in the African continent, then its people will be able to enjoy a more comfortable lifestyle from having electricity. Their health will improve because they do not have to inhale toxic fumes from burning biomass for fuel. Solar energy is free after the initial purchase, so the money that families save on fuel can be used to improve their economic situation.

Finally, solar energy has many environmental benefits because people do not need to cut down trees for fuel, which will save forests and reduce carbon emission.

A More Comfortable Way of Life

People in the developed world take it for granted that they have electricity, and most people do not appreciate what big part electricity plays in their daily lives. For many African families living in the rural regions of Africa, power lines bringing the capacity for electricity and telecommunication cannot reach them because their home is too remote. Many African governments are very unstable or corrupt, so they have little motivation to bring electricity to poor African homes that cannot bring them any financial benefit. Some governments do not see the worth of bringing electricity into an area to power only a few homes. Sometimes, too, the state is too poor and must allocate its funds to matters that it finds more pressing. People who are lucky enough to live on the grid usually experience frequent blackouts. So, even in the twenty-first century, many families still must live most of their lives without electricity. The interior of these homes are dark and are usually lit by the dim, eerie glows of kerosene lamps. The odorous kerosene exhaust pervades these homes, suffocating their inhabitants.

If these families had access to solar energy, their homes would have electricity that is readily available and reliable. They can use this energy to power lights, illuminating their homes in bright light instead of the shadowy light that kerosene lamps emit. People will no longer need to burn kerosene for light or fuel. Solar energy can also be used for other appliances, such as stoves, televisions, radios, and water pumps. All of these appliances will work well under Africa's strong sunlight, and families do not have to fear that they cannot use an appliance because of blackouts. Families have more hours in a day instead of having to sleep at sundown, so there is more time for

family activities. Children can study for longer hours at night with ease, leading to better results in school. Women's lives will be greatly improved by electricity because they are usually responsible for acquiring fuel for the family. With electricity, they will not have to spend hours of the day gathering wood or animal dung for the stoves, or walking for sometimes six hours (Sachs 19) to fetch water because they can use a solar electric water pump. With electricity, their time can be devoted to more productive activities, such as raising their children or learning a new skill. 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. Because kerosene lamps will no longer be used, there will also be less fire hazards from knocking over these lamps.

A Healthier Option

Solar energy will greatly improve the health of African people because their current energy options are very health hazardous. People can benefit from improved eyesight, especially children who have to study at night, because electric lights are much brighter than kerosene lamps. 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 pulmonary diseases and other health conditions that occur from inhaling toxic fumes (Sachs 19). Using solar water pumps means that people have the option to obtain water from a clean water source. Many people are restricted by the issue of distance, and people have to gather water from the nearest practical source of water, even if this source is not very clean. Electrified water pumps can draw water from farther sources that are cleaner for drinking. Hospitals will also be able to take care of their patients better. Many hospitals suffer from unsanitary conditions because the facilities

are too hot or there is no clean water. With electricity, hospitals can easily access clean water by using solar electric water pumps. Electricity also means that medicines and vaccines can be refrigerated and kept for a longer time, decreasing occurrences of spoiled medications.

Economic Advantages

Using solar energy will save families a lot of money. After the initial set-up of the solar energy system, there are virtually no more fees except for the occasional maintenance fee. Sunlight is a free resource that is available to anyone, so this option is very good for poor families. Electricity will also bring more light into homes, which means that people will have more hours in the day to work. For business people, more hours in the day could mean that they can balance the books longer, or sew clothes for more hours, or open their shops later, leading to more productivity and more money for the family. This increase in productivity will give them the ability to buy more commodities and have more comforts of living. People can save money by not having to buy kerosene for fuel, especially because the price of kerosene is quickly increasing. It is estimated that families spend twenty percent of their income on fuel alone (Browne). If they did not have to buy any more fuel, they can use this twenty percent for bettering their economic situation and lives. Also, solar energy is more reliable than other sources of energy, so people will not have to worry about constant blackouts or running out of money to buy fuel, which would disrupt their productivity cycle. They can continuously use their time for activities that are more beneficial to them and their families.

Environmentally Sound

Solar energy cuts out the need for conventional energy sources, which are non-sustainable and detrimental to the environment. Oil is currently the most sought after

form of energy in the world because of its vital role in transportation, but oil must be drilled, which destroys natural sites where these oil wells are found. Also, oil is quickly running out and causes many political issues as states try to use their oil reserve for political leverage over other states. Oil, when burnt, emits a lot of carbon dioxide into the atmosphere, exacerbating the current global warming problem. In Africa, the burning of oil, natural gas, coal, and wood to make electricity releases many toxic substances into the atmosphere. This is harmful to people's health, but it is especially worrisome because the global climate is on the brink of reaching irreversible warming, which will then lead to many other natural disasters. Using solar energy will mean that people in Africa, and all over the world, do not need to rely on these conventional forms of energy but can use a clean, safe, and sustainable source of energy. Less carbon dioxide will be emitted into the atmosphere because there is no more burning of fuels (ENDA-TW 37), which will help the world reach its carbon reduction goal. Poor families often use wood for fuel because there is a huge abundance of wood available, but this has led, in recent years, to vast deforestation problems. Deforestation also contributes to global warming because forests process a lot of the carbon dioxide in the atmosphere and are a carbon sink. When forests are destroyed, the carbon that they contain is released into the atmosphere, further hurting the environment. If people no longer need wood for energy, they will not need to cut down forests or burn them for fuel, which will help with combating global warming. Many people use battery-operated appliances because they do not have electricity, but old batteries are environmentally hazardous because they contain many toxic chemicals which can leak into the ground and contaminate the land when they are not discarded properly.

With solar energy, people do not have to use batteries, or they can cut down on their battery usage, avoiding hazardous disposals of batteries.

Obtainability of Solar Energy Technology

Solar energy has been around for many decades, and many people have worked with the technology enough that it can be easily manipulated to fit into any situation (Karekezi). The CSP system can be incorporated with the current power lines. Instead of burning fuel for heat to turn the turbines, sunlight would be used to make that heat, and then the rest of the electricity generating system would be the same as a conventional electric generator. Thus, states do not have to radically change their current energy structure if they wanted to be more sustainable and adopt the CSP system.

Solar energy technology has become cheaper, especially with PV technology. PV appliances were very popular in the 1980's, so there was large production and a large fall in international market prices (ENDA-TW 141). Now, the technology is even cheaper than it was before because of more innovation, differentiation, and availability of the technology.

Certain places in Africa have a credit system, which makes it easier for families to make the initial payment to acquire solar technology. For many African families, the upfront cost of solar technology is out of their budget, so they cannot afford to buy solar technology even though it would save them a lot of money in the long run. Many small-scale credit systems are starting to appear in different areas to make capital investment easier for people. The African Rural Energy Enterprise Development (AREED) is a United Nations Environment Program (UNEP) initiative that provides initial funding and entrepreneur training to people who want to start or expand a business in the field

of clean energy in rural or semi-urban areas. They assist people in starting up a business by providing planning, structuring, and financing. They also provide loans and partner with banks and NGO's that work with rural energy development (AREED). With different institutions like this one, people who have problems with initial start up funds are able to afford a solar energy system. They can then use the money that they saved from not using conventional fuel to pay back this loan.

Solar energy systems are very durable. The CSP system can last for about twenty years with only minor breakdowns. PV panels can last for about twenty years with minimal maintenance. Even with small appliances that are used on a day-to-day basis, the appliances can last for many years before needing to be fixed. Thus, solar energy technology is very durable, and despite their initial cost, they save a lot of money in the long run.

The PV system is also a good choice for poor, rural families because the technology can easily be brought to remote areas. Families who are not connected on the electricity grid, or families without any electrical wiring in their homes, can still benefit from small electrical appliances that are solar powered. Thus, solar energy systems can bring more comfort to families who have simple homes that do not have an electrical structure. Thus, the range of complexity of solar technology is so diverse that it can fit almost anyone's needs, from very advanced solar energy systems to very basic PV electrical appliances. Dr. Gabriella Lesino, from the Universidad Nacional de Salta in Argentina, stated at the United Nations Conference on Environment and Development in June of 1992, "It is very difficult to talk about technical barriers without thinking of economical, political, cultural, and social problems. They are all interconnected. It is very difficult to find a purely technical barrier. I am not convinced

that they exist (International Solar Energy Society)[9]." Thus, the fact that solar energy technology has been around for decades but is still not widely used is not because of technological hindrances. The technology is there to harness the power of the sun. The problem lies with structural problems that are long embedded in society.

Barriers to Obtaining Solar Energy

Africa seems to be the perfect place to begin the trend of adopting solar energy. Indeed, it seems to have all the pieces of the formula for using solar energy: it is sunny; it is a poor continent, so it should want to convert to a renewable source of energy; it has a motivation to switch its current energy habit because its current reliance on non-renewable forms of energy is causing many social, political, economic, and environmental problems; and the technology to capture solar energy already exists, so it can easily incorporate it into its society. However, "Africa has a lot of sunlight, but other factors are not present to sustain this technology," said Vicente Yu[10]. 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 propagation of solar energy highly difficult.

The Problem with Demand

If Africa truly adopts solar energy as its main source of energy, African people's lives would be greatly improved. However, many African people do not even

[9] In 1992, leading experts on solar energy attended the United Nations Conference on Environment and Development (UNCED), led by the International Solar Energy Society. They met to discuss different renewable energy initiatives of their energy how to make renewable energy more of a priority. To see a transcript of the discussions that went on that day, see International Solar Energy Society. *Solar Energy Solutions for an Environmentally Sustainable World.* ISES. June 1992.

[10] Vicente Yu Vicente Paolo B. Yu III. Programme Coordinator, Global Governance for Development Programme, South Centre. *Personal Interview.* 16 November 2009.

know about this technology to want it. Africa's difficulty is that it is largely still a rural continent, with people living in small villages that are spread apart and hard to reach. Many agencies or bodies have a hard time reaching these places. Many non-governmental organizations (NGO's) travel from village to village, holding seminars about solar energy products and their benefits, but these sessions can only reach a few people at a time, and the process is very slow and grassroots. Despite the great amount of effort put into this educational process, many villages are too remote or have not been reached yet. The remoteness of these villages also means that information from one village cannot be relied upon to travel to other villages. In urban areas, communities are closer together, so information can spread faster. In rural areas, on the other hand, travel between villages are seldom and information does not move as quickly or may even stop with a village, so technology use in one village may not spread to other villages. Sometimes solar energy technology is given or sold at a cheap price to people who seem like they would be good at spreading the knowledge, but they end up not advertising the technology to anyone (ENDA-TW 84, 98-99). Thus, this publicity technique ends with that person and other people still do not know about it. So a big road block to solar energy lies with the remoteness of African communities and being able to span the distance to effectively communicate information about solar energy to these many communities. If people do not know the benefits of solar energy, or that solar energy technology even exists, then they will not have a demand for it.

Even if people in Africa know about solar energy, another issue with solar energy in Africa is that people may not even need it or see the value in buying such a system. An African farmer usually wakes up at sunrise, works all day, eats dinner with his family, and by sunset he is exhausted and must go to sleep so that he has the strength to work

all day the next day. His life is synchronized with daytime hours, so he does not need to have electricity at night for light. Some people are so poor that they do not have any electrical appliances, so they do not need electricity. Many families do not have an electric oven, radio, or TV (ENDA-TW 8, Yu), thus giving them electricity would be useless because they do not have any appliance with which to use it. This has been a major problem with installing communal PV systems in the past. Once these systems were installed in the community, the organization that installed it thinks that the people of that community will greatly benefit from electricity, but many people do not sign up to be part of this service because they do not have a need for electricity (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, or there may not even be a school in the area for them to go to. Thus, these children do not need a light late at night to work (Yu). These people have lived without electricity their entire life, so they are used to being without electricity and do not need any electricity, even if the electricity is handed to them.

Families may have more pressing concerns than energy worries. The life for most Africans is very difficult. Many families worry about their meals from day to day. Securing food and water is a major concern, and electricity is a luxury that they cannot afford and can live without. Rural farmers have to worry about growing crops because that is their main source of income. Even after all their hard work, they barely have enough money to survive, so they have to spend money on more pressing concerns such as food or clothing. Another worry that often plagues the African household is diseases, such as malaria, that thrive in the hot climate. If they cannot even afford bed nets for

their children, they will not spend that money to get a new solar energy technology that would make their lives more comfortable but not guarantee their survival any more than before (Sachs 18). Many regions of Africa are rife with internal conflicts (Zurcher). These wars and political conflicts lead to high instability and high insecurity. Thus, if their lives are not even secure, they have much more crucial matters to worry about than how they will get electricity or whether their current energy source is environmentally friendly.

One of the biggest problems, and the hardest issue to overcome, is the financial situation of a typical African household. Solar energy is still too expensive for many African families, despite their lower price. The PV-grade silicon needed to make PV cells are expensive to produce (Desertec), so it is difficult to lower the price of the technology any more to be affordable to the 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. To install a PV water pump system, it would cost about $15,000, which is still very expensive for the average citizen (ENDA-TW 145), even if this cost is split between many families. "With all their advantages, solar systems are not cheap to install," says Mr. Jem Porcaro, an analyst for the Energy and Environment Group at UNDP. "A typical home system in sub-Saharan Africa costs anywhere between $500 and $1,000, and such systems typically provide enough power to light three to six rooms and power a black-and-white TV each night. But the cost is well beyond the means of most African households (Madamombe)." Most company websites that offer solar energy services for grand scale installations, such as for hospitals or municipal buildings, where technical details and price quotes

need to be discussed. This shows that solar energy today is targeted towards public institutions because companies know that the average citizen is too poor to afford their service.

Because these larger systems have not been adopted by the masses, some entrepreneurs are starting to break down the packages into smaller, more affordable units. An LED lamp from ToughStuff is about $30 (ToughStuff), but for families that live on a dollar a day, this low price is still too high. Nancy Bacon, from the Energy Conversion Devices, Inc., USA, said, "There is no doubt that, even at today's cost for photovoltaic technology, we can make a very good case that the life-cycle costs of these photovoltaic lights are a much better option than kerosene lanterns. But that is on a life cycle basis, and there are not many people that can afford to pay ten years of energy costs all in one day (International Solar Energy Society 2)[11]." Despite their lower prices, families cannot afford to spare the initial payment to acquire solar energy technology.

Environmental degradation is making it even harder for African families to afford better forms of energy. Deforestation is becoming a very big issue, and this means that families are finding it harder to find wood fuel for their stove. Without fuel, they must work harder to pay for oil, coal, or kerosene to replace the wood that they had, which means that they will have less money to switch to better fuel options. Soil erosion is harming crop yield (ENDA-TW 8). Climate change is also hitting these farmers the hardest because unpredictable rainfall leads to water scarcity and failed farming (Global Green New Deal 2). These farmers depend so much on tenuous environmental factors for each harvest. For these subsistent farmers, a bad harvest would mean that they will have a much harder time to buy food and necessary provisions. With harsh

[11] Quoted at the UNCED 1992

living conditions and economic difficulty, it is even harder to switch to a better energy source.

Although credit systems are beginning to multiply in Africa, there are still no credit systems in many places (Archer). Places where people need credit the most, i.e. rural, remote regions, are usually places that do not offer credit services. Thus, the poorest regions are receiving the least help. Sometimes people are so poor that they do not have enough credit to borrow money, even though they live in a place that does have a credit system (Sachs 19, Zurcher, Cadestin). With the current credit system, the poorest of the poor are still not helped because their substandard situation falls outside of the helpable credit realm, even though these people are the people who need help the most in society.

The availability of other fuel sources also distracts people from wanting to switch to solar energy. When people see that other fuel sources are available and easily accessible, such as wood, they feel less compelled to switch their current consumption habit. Some regions have free access to wood for fuel. Because of this, Africa's forests continue to be destroyed at a very rapid rate (*The Millennium Development Goals Report 2009* 40-44). If wood is not available, people can gather cow dung or other biomasses in their backyard for free, so they do not want to switch to solar energy where they will have to pay, albeit the main payment is only once (ENDA-TW 8). Solar energy looks like a clean alternative, but people's current situation is not desperate enough to switch, especially if they still have access to free wood and biomass for energy.

A fundamental problem with solar energy is that its technology usually originates from international origins, so they do not fit well with the local environment and leads to

many technical problems. A good demonstration of how imported technology is problematic is the story of the Danish windmill. The Moroccan government wanted to build a windmill farm in Western Sahara. The project was put up for bid, and in the end, it came down to a Danish and an Indian windmill company. The Danish company finally won the rights for the project. The windmills were installed in Morocco and operated very well for about a year. Then they started breaking down, one after another. Because the technicians were Danish and Morocco did not have qualified windmill technicians, the Moroccan government had to fly in these technicians. Then it had to fly in Danish windmill parts because these parts could not be manufactured in Morocco. This cost the Moroccan government a lot of money, but the windmills still kept breaking down. Finally, people realized that the reason why the windmills kept on breaking down was because sand got into the parts and the Danish windmills were not built to stand in sandy environments (Yu). The Moroccan government realized that the Indian company would have been the better choice because it has had a lot of experience with building windmills to withstand desert storms. Thus, technology must be adapted to its location. People cannot simply import it from other nations and expect the technology to work exactly as well. The windmill story demonstrates that if technology is imported to a place that is not yet technologically advanced, there will be issues with maintenance, acquiring parts, and adaptability of the technology to the local conditions.

Solar technology, unfortunately, is not manufactured in Africa. The company called Solar Energy for Africa, for example, sells products that are imported from the United States, United Kingdom, Germany, and Switzerland (SEFA). Mainland China and Hong Kong are major suppliers of solar panels, exporting even to places that have their

own solar panel manufacturers, such as the United States, Germany, and India. The only state in Africa that has a solar energy technology manufacturer is South Africa. Thus, solar energy becomes another case of exporting Western ideology into a culturally different region and causing dissonances with the local population (Cadestin, Yu). The local culture does not really adopt it, and they do not have the technical knowledge to sustain it.

Like the windmill example, when the parts of a solar energy system break down, the replacement parts have to be imported. The local population does not have the technology to fix the complex mechanism that occurs inside of a solar energy system. PV panels are especially difficult to fix because they involve many separate parts. Companies in Africa cannot produce the complex parts of a PV system if they break down (ENDA-TW 32). This makes it risky to invest in solar technology.

Another example is in 1987, Ethiopia began supporting a water pump system, but people did not know how to use the pump. The local government tried to hold training sessions to teach people how to use the pump, but this was still inadequate and many people were confused about how the system worked. Also, people hired to manage the system were ineffective, leading to frequent breakdowns (ENDA-TW 145). There was not sufficient expertise in the area to maintain the pump.

PV systems are relatively easy to maintain because rain and snow usually washes off the dirt on the panels. The easiest way for PV systems to break down is when dust gets in between the cracks of the solar panels. But it does not rain all year round in Africa and many areas are often dry and dusty, so dust particles can stay on the panels for a long time and damage the system. In the past, because this technology was imported, experts were not there to teach people how to take care of the panels, so

they broke down and people lost faith in solar energy. The technology did not fit into the development level of local culture and caused social dissonance.

The remoteness of some areas leads to very regular technology breakdowns because of poor maintenance and poor surveillance of products. There was a case of stolen batteries from one solar power system because it was built in a secluded place and no one was there to keep an eye on the system (ENDA-TW 41). These machineries usually break down because there is no one there to maintain them on a regular basis. Once they break down, there is little technical knowledge available to fix them.

Lack of trained technicians also means there is no after-sale maintenance, making it highly risky for buyers. Most solar energy service providers offer guarantees for only a year. Companies have very little incentive to return to remote places for maintenance service because their main income comes from selling the product. If after sale maintenance is offered, it is probably very expensive because technicians must travel to remote places to fix the problems, and locals usually cannot afford the service fee anyway. "The best way to combat this problem is to have natives install these systems in the first place, but they do not have enough knowledge to do it themselves," said Vicente Yu[12]. People also thought that the systems could do more than they could. When the solar water heater was first installed, people used it excessively during the wintertime because they believed in the high performance of this system. This caused many breakdowns and demand for after-sale service was high, but companies were not prepared to offer this service (ENDA-TW 83). After that, people

[12] Yu III, Vicente Paolo B. Programme Coordinator, Global Governance for Development Programme, South Centre. *Personal Interview.* 16 November 2009.

lost faith in the solar water heater and did not recommend it to other people, so demand for it went down the next year.

Most of the solar energy projects of the past have been sponsored by international organizations or bodies. These donors paid for certain systems to be installed, but sometimes they are not the best apparatus for the community. 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. This data chart of Kenya's PV installation shows the number of PV systems installed and also the funders for the programs.

Estimated Number of PV Systems Installed in Kenya (1993)

Application	Number Installed	Estimated kWp	Customer
Vaccine refrigeration system	450	90	Donors/NGO'S
Home lighting system	>20,000	>600	Private
Water pumping systems	50-70	70	Donors/NGO's/Private
2-way radio power supply	>200	>10	Government/NGO's
Cathodic protection	>3	n/a	Government
School/mission power and lighting system	>100	>10	Donors/NGO's
Repeater stations	>40	40-60	Government
Electric fencing	>200	7	Government/private

Source: ENDA-TW 141

All of the projects were partly or fully funded by donors, NGO's, or the Kenyan government, except for home lighting systems (ENDA-TW 141). Giving African people solar energy is like teaching them how to fish with an imported fishing pole

(Anonymous). They can fish for themselves for a while, but when their fishing pole breaks, they do not know how to fix it because they were not taught this knowledge, and they cannot get replaceable parts because these parts were manufactured in a different country. So in the end, they are back to waiting to be given a fish. All of these problems with the PV solar system raise the risk of investing in one.

The Problem with Supply

Even though there is an abundance of sunlight in Africa, the demand for solar energy is small because of the reasons mentioned above. Lack of demand causes many problems for entrepreneurs interested in entering the solar energy business because there are many barriers to entrance and the risks of failing are high.

It is difficult for solar energy suppliers to install products because it is hard to access remote regions. Many huts do not have paved roads leading to them, so it is difficult to bring in equipments for installation and repair. If the roads do exist, they are usually in bad shape because the state does not maintain them very well. It is also difficult to reach remote families to advertise their products, so the solar energy market stays small.

Countries in Africa also have a lot of political issues, which makes being an entrepreneur very dangerous in these parts. 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). Many African countries also lack infrastructure. In Sub-Saharan Africa, only one in four people is connected to a grid, and in rural areas, only one in ten people is connected to the grid

(Karekezi). This means that only some people have the option of installing a CSP system in their community. This also means that only a few homes have the correct structure to install a full house solar panel system, a service that many of these companies specialize in. These companies must also think of cable installations for the home, or what kinds of machinery can the home support, when they install a solar energy system. All of these factors make business more difficult for African solar energy companies than for companies in other areas of the world.

Many entrepreneurs who try to invest in solar energy in Africa go bankrupt because the existing market is too small to be sustainable. To be a solar energy supplier in Africa, the entrepreneur must pay a high start-up fee for the initial investment in equipments because most of the materials have to be imported (ENDA-TW 114). The market for solar energy in the private sector is usually quite small. The individual household sector is normally too poor to pay for their services (ENDA-TW 8). Most projects come from public funds. The bulk of these companies' profit comes from these large, public projects, such as light installation for a military building or refrigeration for a clinic. These big projects occur only one in a while, however, and many companies fail to survive in the interim between projects. Small start-up companies have a very hard time surviving. The high barriers to enter the market, along with the high failure rate, discourage many entrepreneurs who are possibly interested in solar energy.

The Political Obstacles

Most African states are highly unstable and rife with political conflicts. Their history of being colonized has greatly disrupted the social order of the continent, forcing different ethnic tribes to live together in the same state and dividing tribes. Thus, there is a lot of political tension and people strive to gain power, and then they are quickly

overthrown by others who feel they have more right to power. Many regions do not adhere to the national government but are ruled by regional warlords (Ahmed). Insecurity makes it highly difficult for families to thrive (Zurcher). The progress that a state has made since colonization is soon destroyed by the conflict in the region (Fall), so Africa remains an underdeveloped continent despite many years of independence. Liberia has invested a lot of money to building up its infrastructure, but much of that was destroyed during its civil war. It will now cost Liberia $107 million and many years in order to restore power plants and national transmission lines to pre-civil war state. Angola and Mozambique have the same problem (Desertec-Africa). The lack of infrastructure makes economic growth very difficult (Yu). Rwanda is only now recovering slowly from its period of genocide (Fall). It has many years left to grow, and needs to retain peace, in order for the state to develop and conditions are safe for investors again.

Besides political instability and lack of infrastructure, energy is not a big concern to African governments, so there is little public investment. Most energy initiatives must come from the government level in order to have a wide impact, but governments feel they have more urgent issues to deal with, such as political problems or the financial crisis. They do not see that renewable energy is an important issue, especially when they are used to and still have access to conventional energy sources such as oil and coal. Setting up a statewide energy system is also extremely complicated. Besides installing the large energy generating plant, states will also have to consider how much it will cost to connect the many homes to the grid in order to receive this power. Dr. Harry Tabor, from the Scientific Research Foundation in Israel, stated, "It is very difficult to get any finance minister to make a financial commitment in order to solve a problem

that is going to arise in ten or twenty years (International Solar Energy Society 2)[13]." Indeed, states do not yet feel the need to switch to renewable, solar energy. Sometimes, states can have very impractical reasons for not wanting to invest in an electricity system. When UNESCO declared Cape Verde a UNESCO heritage site, Cape Verde stopped its plans on building a PV system because it wanted to preserve its current look (ENDA-TW 79). Renewable energy was less of a priority to Cape Verde than retaining its UNESCO status. States need an impetus to spur it to action in investing in solar energy, and right now no event has been big enough to cause this. Solar energy still remains simply an option for the future.

Many nations are still dependent on foreign aid. Because they are so used to receiving aid, they are still waiting for aid, even though this money might not come (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). The problem with donors is that they usually have criteria for projects that might not be the most suitable thing for the country (Dixit). Donors choose the projects that they want, so the nation cannot decide where to use the money, even though another option could have been better for the nation's situation, such as investing in an electrical grid system. Most thermal solar energy development projects of the past were funded by France or the United States (ENDA-TW 82) because they thought that this would be good for the country. However, the entire project was done in a Western manner, with Western technology and implementation method, without much consultation with the inhabitants. After the international organizations left, the local people did not adopt the project, so the project was not sustained.

[13] Quoted at the UNCED 1992

States that have tried to invest in renewable energy technology have made calculations error in the past. They usually devoted about eighty percent of their entire fund to the implementation of the project. After the project was completed, there was very little fund left for maintenance fee so the product usually broke down and the community could not benefit from it. They also did not have enough money to train experts to maintain the system. Their short sightedness has caused these highly beneficial projects to fail. Because African states are very ineffective, it is easier to implement the PV system instead of the CSP system for the poorest people because these do not need to be connected on a grid, but decentralized, individual systems have all the start-up obstacles mentioned earlier (Yu). States need to find ways to implement energy policies that will be sustainable in the long run.

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. "What often works best is introducing a concept that the community thinks it needs," said Vicente Yu from his experience as a community coordinator[14]. This way, the community will value and sustain it after Western forces have pulled out. NGO's and other energy organizations should continue to give presentations and educate people

[14] Vicente Paolo B. Yu III. Programme Coordinator, Global Governance for Development Programme, South Centre. *Personal Interview.* 16 November 2009.

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.

If interest lies in a communal energy system, then people need to make available technology that would make this electricity beneficial. If the electricity system is installed so that the family can use it with their electric stove, but the family actually does not have an electric stove, then the electric system would be of no use to them. 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. In order to make an intervention effective, people must consider what else the local population needs (Yu). Thus, just installing the solar energy system is not enough, but other factors must be accounted for to make sure that the entire system actually goes to benefitting people's lives.

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. They should assess the ground situation to see what is needed and what is not needed (ENDA-TW 47). This way, they can also see what was overlooked so that they can make their intervention more

effective. 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. Reassessment is crucial in securing the success of any measure because the original plan may have overlooked many crucial details.

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. This would make the system more sustainable because people can repair the technology themselves. The local community needs to be empowered in order to make them more independent and sustainable (Anonymous). Some of the recommendations by the International Panel of Experts on Desertification were, "sensitization of the users to the maintenance of their equipment," and, "support to decentralized structures when it comes to management maintenance (ENDA-TW 48)." In order for solar energy to continue being effective in the local community, the inhabitants must be able to take care of the system and repair it themselves if they need to. They cannot become dependent on a technology that they did not produce (Yu). If the local community does not adopt this project, then it will collapse after the enforcing body leaves. Therefore, locals must be taught the value in such a project's success, and how to sustain it themselves.

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. It would diversify the job profile of the community because these people can start their own business. 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[15]. 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, then 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. People are already doing this for agriculture, such as to buy seeds and manure (Zurcher). This method can work for solar energy systems as well. This way, the community can afford something that is beneficial for everyone that they could not have afforded alone.

NGOs interested in encouraging solar energy use should try working more with the local government. Local governments are usually easier to access and less corrupt, so it is much easier to form a collaboration with them (Cadestin). People know each other, so it is easier to work. Local governments are more likely to support NGO's than big governments because there is less bureaucracy (Zurcher). The decentralized system works on a smaller scale, so it is easier to manage (Dixit). Working with the local government would make it easier to adopt the decentralized electric system for an area and skip through all the bureaucracy.

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).* They can focus national governments'

[15] Roger Zurcher. Food for the Hungry. *Personal Interview.* 5 November 2009.

attention on sustainable energy options. If change came from top down, then the individual household cannot see the benefit, or the benefit reaches them very slowly. If the change is bottom up, then the effect is too slow and too little. Thus change should come from both directions and meet in the middle (Dixit). If smaller, more grassroots organizations worked with the local governments while larger, international organizations worked with the national government to encourage solar energy usage, then a lot of progress can be made.

Africa should recognize that energy security is a priority, and that solar energy can be the solution. African governments should recognize how important it is to bring electricity to its people and how much their lives will improve. They must place emphasis on these sustainable energy projects and look for durable solutions. One way to make African governments see the value in renewable energy is by showing them the unsustainable nature of their current consumption pattern. The current carbon emission and deforestation is not a long term option for them given how much their forests have been depleted. Eventually they will run out of resources and be even worse off than now. If they can be made to realize the short lifespan of their current consumption pattern, perhaps they will be more persuaded to switch to a renewable energy source, particularly solar energy.

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 do a great deal to encourage the use of solar energy technology.

"Environmentally friendly policies and development policies can be complimentary," said Etienne Cadestin, "we just need to get the government to invest in the right places, like solar energy.[16]" Governments should establish a framework for investment and then step aside to let businesses grow (Johnson-Sirleaf and Oppenheimer). If they do not have money to create a national grid system, they can try setting up "smart" grids in certain areas, which are small-scale off-grid technology areas. These can better cope with a decentralized and fluctuating energy supply, and can also support a system of private feed-in. Governments can also invest in improved power storage and carbon capture and sequestration (Global Green New Deal 8). This way, the environment can benefit from low carbon emission and less deforestation. 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 products for cheaper to customers, thereby making it 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 small-scale projects are becoming much more

[16] Cadestin, Etienne. Consultant, United Nations Environment Program: Economics and Trade Branch. *Personal Interview.* 28 October 2009.

common[17]. In Djabula, Mozambique, the National Electricity Fund created a PV station that can power forty-five homes. Some governments are also finding it helpful to team up with private organizations in its solar energy initiative. In Ethiopia, the Ethiopian government paired up with a Swedish company called Solar Energy Foundation to build an off-grid solar PV system in Remu that brought power to 10,000 people and charges less than $2 per person (Browne).

A current initiative in Chile might also be worth implementing in Africa. In 2005, most people in Chile used incandescent light bulbs, which uses a lot of energy and are not as environmentally friendly as compact fluorescent lights, or CFL's. The Chilean government decided that it wanted to help the environment and the Chilean people by giving people CFL bulbs. It cooperated with the National Light Bulb Replacement Programme (NLBRP), National Energy Efficient Program (PPEE), Sodimac (private light bulb supplying company), and National Association of Electricity Companies to identify the poorest 40% of the population. These people were told that they would be given two free CFL bulbs if they traded in two incandescent light bulbs. The NLBRP, PPEE, and Sodimac all helped to publicize the event and pass out the light bulbs. Now, many poor families who could not afford CFL bulbs have them, and they are saving a lot of electricity and money each month from the more energy efficient light bulbs (Borregaard and Mellado, *Environment and Poverty Times* 18-19). This is a good demonstration of how public and private partnership can work together for the same

[17] To see an assessment of solar projects that were implemented in Africa in the early 1990's, see ENDA-TW (Environment and Development in the Third World "Energy Programme.") *Assessment of Solar and Wind Energy Utilization in Africa.* International Panel of Experts on Desertification. United Nations. Dakar: December 1994.

cause. Perhaps African governments can, in a similar fashion, apply this method to solar energy where people can trade in their kerosene lamps for a solar energy lantern, or their gas stove for a solar one.

A very great, successful model that people are trying to imitate right now is the Grameen Bank's efficient energy model. 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 trained local technicians and users on how to use the PV solar systems. It 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. It created a scholarship program for schoolchildren and taught them about renewable energy technology. It trained rural housewives how to take care of the system. 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.

Smaller organizations are trying to affect change from the ground up. ToughStuff is a social enterprise that sells small solar lanterns, stoves, phone chargers, and radios for a cheap price. Solar LED lights cost about $12 to $14 (Cheng-Tozun). It also tries to encourage local entrepreneurs by selling them a small starter kit that includes several solar energy equipments, which can then be resold in separate pieces. Each starter kit costs $30, which is in the price range of some families. ToughStuff also trains interested entrepreneurs about business methods so that they can become better businesspeople (ToughStuff). Another organization, SolarAid, sells these starter kits for $20 (SolarAid). The hope is that these kits are small enough so that they can be affordable, which gives people some capital to start a business.

There has also been work on solar energy technology. Vivian Alberts and his team of researchers from the University of Johannesburg recently made a breakthrough on solar panels. They have been working on solar panel technology for thirteen years before they invented a new kind of solar panel that is thinner and cheaper than current solar panels. Their solar panel, called the copper-indium-deselenide (CIS) thin film solar panel, is up to 50% cheaper than the current technology (Johanna Solar Technology, Sharife). It can convert sunlight into electricity in a broader light spectrum than conventional PV panels, so it can still generate a lot of electricity even in low light. The technology was patented in 2003, and a pilot run facility was developed and used between 2004 through 2006 (van de Merwe). The technology faced some technical difficulties and funding issues, but now it is supported by both private and public funds

and is set to be commercialized in October of 2009 (van de Merwe). Hopefully with this new technology, solar panels can be more affordable and become more widely used in African homes.

A solar energy project that has received a lot of attention because of its viability of bringing solar energy to thousands of people is Desertec[18]. Desertec wants to build a huge CSP plant in the Saharan Desert. The energy gathered from the Sahara alone can be enough to power all of Europe and Africa, and Africa actually has two more viable deserts: the Kalahari and the Namid Deserts. The run-off heat from this CSP plant can also be used to desalinate water, alleviating Africa's issue of water scarcity. The technology exists to install this system, but the biggest impediment is once again funding. In order to build the CSP plant in the Sahara, thousands of kilometers of electrical cables must be built below the Mediterranean to connect the plant to energy consumers. It would need $465 billion over forty years to build the new cable system (Walt). $83 billion will be needed to make Saharan thermal solar power an attractive and viable prospect for private investors (International Institute for Applied Systems Analysis, *Our Planet* 13). A lot of energy is also lost when it has to travel such long distances. Thus political action is slow. If this project ever gets enough support and funding, it will change how the world is using energy. Hopefully enough political will can be riled up in the near future to initiate this project.

Thinking toward the Future

[18] The Desertec website contains links to many reports about solar energy usage and gives a very cogent argument about the feasibility of CSP plants. See http://www.desertec.org/en/.

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 can be a sustainable and lucrative trade that can bring prosperity to its people if it is managed correctly. 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 leads 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. Many efforts are trying to make Africa a solar energy powerhouse; some efforts have Africa's welfare in mind, and some efforts are just for the West's own gain. Solar energy in Africa is an abundant energy source that can bring energy to the entire world, and African and non-African states should work together to make it a usable energy source because the current problems of climate change, widespread poverty, and energy security are no longer unilateral problems but problems that everyone has and must face together.

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ISP Work Journal

ISP Work Journal

Date	Hours	Activity
9/10/09	1	I discussed with my host mom about my ISP project, and she gave me some possible topics that she thought could be interesting. Some of the things she mentioned were: racism in Geneva, Swiss diplomacy strategy, voting preferences, and childcare and its impact on society. I think I want to research about Swiss fathers and how much time they spend raising their children because my host mother says that most children are raised in day care centers, which makes me wonder what role do fathers play in their children's lives
9/11/09	2	I read up on some articles online about daycares in Switzerland and the usual practice for raising children. It seems that mothers do not spend a lot of time raising their children because they have to work, and fathers spend even less time. I found an interesting article about how Switzerland adolescents have a very high suicide rate.
9/14/09	.5	I wrote up my first ISP proposal for my meeting with Dr. Csurgai tomorrow. I will research about Swiss fathers and how much time they spend with their children depending on their job.
9/15/09	.5	I met with Dr. Csurgai for my first ISP meeting. He does not like my idea because he thinks that it is more appropriate for a CDO. He suggests that I narrow down a topic that deals with international issues or politics.
9/23/09	1	I went to the SIT office to read through some of the old ISP papers so that I can get some ideas and see their format. I think the ISP about media's role in conflict is very interesting. I think I want to focus on issues in Africa because I have never done any extensive research on Africa before and I would like to learn more about its issues.
9/25/09	1	Before meeting with Aline, I dropped by the International Environmental House to further discover what materials from there can be used for my ISP research. Environmental issue has triggered my attention lately as global warming is one of the heated issues of today. Also, the Copenhagen Conference on climate change is

		happening in three months. Therefore, I found a lot of information at the IEH and took them home with me.
9/26/09	2	The brochures from the IEH are helpful in narrowing down my topic. I read about climate change issues in different continents, how energy resources can be used as political tools, and alternative energy development in various regions.
10/5/09	2	After the wonderful Brussels and Paris trip, it has been a week of fun and relaxation from thinking about my ISP topic. However, it actually helped me think of a good ISP topic. I went online to search for news and information on sustainable development in developing countries. The materials that I found are rather interesting, such as how Brazil is working to be a greener country and countries in Africa are getting aids from nations for development so they can gain energy resources.
10/7/09	.5	I talked to Professor Lambert about my possible ISP topic. I want to research about the future relationship between Japan and the EU, but I realized that it would be very difficult to find human resources who know a lot about Japan in Geneva. I think I will take advantage of all the resources here and research sustainable development projects in Africa. Prof. Lambert gave me a few suggestions on different ways that Africa can be sustainable. He also gave me a list of contacts, including someone who works at the ICRC. Now I really have to narrow down my topic.
10/11/09	2	I thought about my ISP today and how I can narrow down my topic. I think I want to research environmental sustainable development projects in Africa because I already have a few contacts from the IEH. I've sent a few emails for potential interviews, including several from the IEH and Vicente Yu.
10/14/09	4	I went to the United Nations to do online research about different issues in Africa. Sustainable development in Africa is a very broad topic, which spans areas such as economic sustainability, micro-financing, agricultural development, women's empowerment, and environmental sustainability.
10/19/09	.5	I emailed Colin Archer because I really enjoyed his lecture and would like to meet him to talk to him about what he knows on sustainability in Africa. I emailed Keith to ask him for Vicente Yu's contact information because I know Keith had talked to him after

		the lecture. Keith replied back with Vicente Yu's email address, so I emailed Vicente Yu to ask him for an interview. I also sent an email to Etienne Cadestin, the man from UNEP whom I had interviewed for my ISS paper.
10/20/09	3	I did research at home on sustainable development projects in Africa in preparation for my meeting with Prof. Lambert tomorrow. I am interested in learning more about empowering the local population and how this leads to sustainability. Many projects in Africa of the past did not take into account local people's preference so the local people did not adopt the project. I want to learn how we can empower the local population so that they can have the ability to grow themselves. Vicente Yu had said that he was unavailable all this week, so I emailed him for an interview on Nov. 12.
10/21/09	9	I spoke to Prof. Lambert about how I wanted to research environmentally sustainable projects that could empower the local people. He said that it was a good topic but I would need to narrow down my topic more. He also gave me advice on who I should contact for my interactive research. After that, I went to talk to Colin Archer about sustainability in Africa. After I talked to him, I interviewed Younis Ahmed who also worked at the International Peace Bureau. After looking into the Grameen Bank that Colin Archer talked about, I have decided to narrow down my topic to solar energy in Africa and why it is not more widespread. This seems rather strange to me because Africa has so much sunlight. If Africa can switch to using solar energy, this would be environmentally friendly and empowering the local population at the same time. **See Interactive Research Log for Colin Archer and Younis Ahmed.**
10/26/09	3	Colin Archer had given me several websites with lists of NGO's in Geneva on them. I went through all the websites to pick out NGO's that I think would be able to help me with my research. I then compiled a list of everyone I wanted to contact, the organization they belonged to, and their phone number. I sent a few initial emails to organizations I thought would be the most helpful.
10/27/09	4	I spent all morning sending out emails to about twenty different organizations to ask them for interviews for next week. I had to make a list of which emails worked, which organizations I had to find more information about, and which organizations I had to call.

		Then I went to the IEH to do research on solar energy. They have many brochures there that have great information about environmentally friendly and innovative ideas. I've received some emails from organizations who have declined to give me an interview.
10/28/09	4	I had an interview with Etienne Cadestin who works for UNEP. He did not know a lot about solar energy specifically because right now he is focusing on the upcoming conference for the Global Green New Deal. However, he was able to give me a lot of resources that I could look into, such as environmental magazines and the newest UNEP Global Green New Deal report. He also gave me the contact information of his friend who works in UNDP who might be able to give me an interview. Roger Zurcher replied to my email, so I sent a reply email to him to confirm our interview time and date. He was very fast at responding. **See Interactive Research Log for Etienne Cadestin.**
10/29/09	2	I read the magazines and reports that Etienne Cadestin gave me to read. One report had a lot of information about solar energy, such as the Grameen Bank system and how it is revolutionizing energy use in rural Bangladesh. I found this very interesting and would like to look into it more. I took a lot of notes on the information that I read to be later put into an outline. I've gotten a few more emails of people who are declining my request for an interview, but FAS has agreed to give me an interview.
11/2/09	3	I went to the IEH library so that I would have a nice quiet place to read the rest of the materials that Etienne Cadestin gave me. I also searched for books that the IEH library may have on solar energy. There is not too many, but I checked out some materials about poverty and sustainable development in Africa. Hopefully they will have some materials on solar energy.
11/3/09	1	I spoke to my host mom about my ISP project. She thinks that solar energy is a good topic and gave me her opinion about why we should convert to solar energy. She thinks that the world needs to act now to switch to solar energy because it is limitless, sustainable, and not harmful to the environment. We had a discussion about solar energy benefits and setbacks, which gave me a lot of ideas for my paper.
11/4/09	4	I went to the United Nations Library to read the books that I had

		checked out before. I learned that solar energy technology has been around for a very long time. This makes me even more intrigued to know why it still has not been widely accepted yet. People have had a lot of time to work adopt the technology, but it is still not a very popular form of energy. I also worked on my outline and organizing my notes. I emailed Avani Dixit to set up an interview with him.
11/5/09	5	I spent the morning preparing for my interview with Roger Zurcher, who works for the Food for the Hungry organization. I wrote out a list of questions that I wanted to ask him. In the afternoon, I went to Geneva for my interview. We talked for a very long time about sustainable development projects in Africa. He spoke about Food for the Hungry's past projects and how their main focus is on sustainable agriculture. He also spoke extensively on the problem with receiving donor money , which is very useful for my solar energy topic because many solar energy projects were funded by international donors. **See Interactive Research Log for Roger Zurcher.**
11/6/09	.5	After meeting with the professors for my ACTFL test, I stayed at the SIT office to look over some of the old ISP's to see their format and all the materials required. I also looked at the topics that people have done in the past and how I should compile my ISP papers. I sent an email to Avani Dixit to finalize where we would meet for the interview, which will be in the cafeteria of the IEH.
11/8/09	.5	I prepared questions for my interviews with Coumba Fall and my Swiss friend's husband who used to work for the ILO.
11/9/09	10	In the morning, I did some online research at home about solar energy and the many different forms of solar energy technology. I especially looked into small electrical appliances that could be powered by solar energy that can be affordable for Africans. In the afternoon, I had an interview with Coumba Fall from Femmes Africa Solidarite. She talked a little about how women can help in disseminating solar energy in Africa because they are the ones managing the African household. After that, I went to another interview with a retired counselor from the ILO. He is the husband of one of the Swiss women that I had met. When I found out that her husband used to work for the ILO, I asked her if I could interview him, and she said to come over to her house and I can get the

		interview. The counselor for the ILO has a very cynical look about the workings of the ILO. His perspective on international organizations is very pessimistic, which is very different from everyone else that I have talked to. However, a lot of what he says is very reasonable, and he speaks from experience of working in the ILO for over twenty years. At night, I prepared questions for my interview with Avani Dixit tomorrow. **See Interactive Research Log for Coumba Fall and Anonymous.**
11/10/09	7	I had an interview this afternoon with Avani Dixit from the UNDP. He talked a lot about development and the structure of his branch of the UNDP. He spoke a little bit about solar energy at the end of our interview. Because he came late to our interview and had to return to work, I could not talk to him for too long. Afterwards, I emailed Vicente Yu to remind him about my upcoming interview with him. I then did more reading on solar energy from the brochures that I had gotten from the IEH and the materials that Etienne Cadestin gave me from UNEP. **See Interactive Research Log for Avani Dixit.**
11/11/09	4	I stayed at home and perused the brochures that I had grabbed from the IEH. Many of the brochures had information about renewable energy and different ways that people are trying to combat global warming, such as building sustainable buildings. I took notes on solar energy to be formalized later in an outline. I also began working on my outline after having taken many notes. I then prepared questions for my interview with Vicente Yu tomorrow.
11/12/09	3	I was supposed to have an interview with Vicente Yu today, so I went to South Center. When I got there, it turns out that he had forgotten about my interview and was actually at the United Nations. Because I no longer had an interview, I went to the United Nations library to do research on the books that I have checked out. There is a book about poverty in Ethiopia which I thought might have information about solar energy usage in Ethiopia, but the information was not very helpful. I also looked at some brochures and magazines that dealt with environmental issues and renewable energy.
11/13/09	3	I went to the IEH and borrowed a few books on solar energy. There is one report about solar energy development in Africa, which is very near to what I am researching. I am very excited to have found this report, and the information it contains is very helpful. I

		spent the rest of my time reading the report and taking notes.
11/16/09	7	**See Interactive Research Log for Vicente Yu.** I interviewed Vicente Yu from South Center this morning. He knows a lot about solar energy issues and has been my most helpful interview. He talked about how solar energy can be beneficial in many ways, but the many factors needed to sustain this technology is not present in Africa. He also mentioned a lot of reasons that I had not thought about, such as solar energy is not widespread in Africa because there is a lack of infrastructure, people are much too poor to afford it, and maybe people may not even see a need in the technology. His interview was extremely helpful and has given me a lot of new ideas for my paper. In the afternoon, I did online research about the possible options for solar energy in Africa.
11/17/09	4	I worked at home today. I looked up information online about Desertec, the company that wants to build a solar energy system in the Sahara Desert so that energy can be transmitted to Europe. I think this idea is very fascinating and will solve Europe's energy security issue. I also read up on the many organizations that are involved in trying to promote solar energy in Africa. I finished writing out my entire outline and emailed it to Prof. Lambert and Csurgai so that I can get feedback from them when I go into the office tomorrow.
11/18/09	5	I talked to Dr. Csurgai about my ISP. After reading over my outline, he told me that I had a very good topic and that my outline was pretty complete to him. After talking to Dr. Csurgai, I went to the IEH to work on my ISP. I read a lot of the materials that I had borrowed from them and took a lot of notes. I also put the notes into my outline.
11/19/09	4	I spent today reading up on many articles about solar energy. I then worked on filling in my outline with detailed information so that when I write my paper I will have all of the necessary information there.
11/20/09	5	Today is the last day to work on the ISP in Geneva. I spent the morning working on my paper at home. In the afternoon, I went to the UN library to write down the bibliographies of the books that I had been using because I cannot take them with me.
11/21/09	4	We traveled all day today, but I have a lot of writing left to do for

		my ISP paper so I tried to work on the bus on the way to Pula. I feel that my sentences are very simple and choppy, and my paper will probably need a lot of revision. After we got to the hotel, I worked on my paper at night in my room. I was very tired but I needed to work on my paper.
11/22/09	10	I wrote the last ten pages for my ISP paper. It was fun to be in the new hotel and working because there is so much space. I wanted to fall asleep in my bed, so I moved to the lobby area to work. Some of the writing took a long time because I had to look up some things on the internet, but the internet was unreliable sometimes so it took a long time to search things.
11/23/09	10	I spent today typing up my work journal. I've just realized that I have done so much work and there was a lot of research done. I also typed out all of my interviewees' information and a summary of my interviews. This took a lot of time because I had to read over all of the notes that I took for my interviews and summarize them into concise sentences. I have also worked on formatting my ISP paper, such as writing out the bibliographies, the contents page, cover letter, abstract, acknowledgements, and headings.
11/24/09	9	Today I spent all day revising my paper. My first draft was hideous, so I had to rewrite many portions of it and rearrange the order. This took a very long time, but I think that it is pretty complete now. Tomorrow I will revise it one more time and then turn it in.
11/25/09	11	I spent all of today polishing my paper. I typed up my bibliography, formatted my paper, placed the sections in the write order, made my table of contents, and revised my paper one last time. I made all the necessary little changes so that my paper is finally ready to be turned in. Then I emailed it in to the AD's.
Total number of hours	152	

Human Resource List

Africa Humanitarian Action (AHA) – Europe
T+41 22 786 7375
F+251 (0)11 551 3851
71, Rue de Lyon
1203 Geneva, Switzerland
Email: geneva@africahumanitarian.org
(Did not respond)

Mahenau Agha
United Nations Development Programme (UNDP)
Tel: (+41 22) 917 84 65
Telephone: (+41 22) 917 85 36/85 37
Fax: (+41 22) 917 80 01
Email: registry.ch@undp.org
UNDP Geneva Office
International Environment House
11-13 chemin des Anémones
CH-1213 Châtelaine (Geneva)
Website: www.undp.org
(Did not respond)

Younis Ahmed
Consultant
International Peace Bureau
Tel: 41 22 731 64 29, Fax: 738-9419
Email: Younis.ahmed@ipb.org
www.ipb.org
41 rue de Zurich, 1201 Geneva, Switzerland.

Anonymous
Retired Principal Counselor of the ILO to UNDP
International Labor Organization
Tel: 41 22 361 98 52
72 Route du Boiron, Nyon, Switzerland

Colin Archer
Secretary-General
International Peace Bureau
Tel: +41-22-731-6429, Fax: 738-9419
Email: secgen@ipb.org
www.ipb.org

41 rue de Zurich, 1201 Geneva, Switzerland.

Christiane Berthiaume
World Food Programme Geneva
Tel: (+41 22) 917 85 64
Email: christiane.berthiaume@wfp.org
International Environment House
11-13 Chemin des Anémones
CH-1219 Châtelaine (Geneva)
(Did not respond)

Olivia Bessat
Peacebuilding Point of Contact:
World Food Programme
Phone: +41 22 917 87 15
Olivia.Bessat@wfp.org
International Environment House
11-13 Chemin des Anémones
CH-1219 Châtelaine (Geneva)
Website: www.wfp.org
(Did not respond)

Business Humanitarian Forum
Tel: +41 (0)22 795 18 00
Fax: +41 (0)22 795 18 09
E-mail: bhinfo@bhforum.org
7-9 chemin de Balexert 1219 Chatelaine (Geneva) Switzerland
(Declined an interview because they were too busy.)

Etienne Cadestin
Consultant
United Nations Environment Program
Economics and Trade Branch
Tel: 41 22 917 86 95
Email: Etienne.CADESTIN@unep.ch
15 Chemin des Anemones, 1219 Chatelaine, Geneva, Switzerland
Roger Zurcher
Food for the Hungry
Tel: 41 022 755 35 75
Email: rzurcher@fhsuisse.org
fhsuisse.org
Dr-Alfred-Vincent 8, 1201 Geneva, Switzerland

Derek Christie
Association Transports et Environnement Section de Geneve
World Health Organization
Email: ate.geneva@bluewin.ch
Health issues related to transportation and the environment.

Avani Dixit
Disaster Reduction and Recovery Team
United Nations Development Program
avani.dixit@undp.org
15 Chemin des Anemones, 1219 Chatelaine, Geneva, Switzerland

Espace Afroamericain
Tel: 022-731-2051
(Did not answer)

Coumba Fall
Representative: PanAfrican, Centre for Gender, Peace and Development
Femmes Africa Solidarite
International Secretariat
Tel: 41 22 328 80 50, Fax : 41 22 328 80 52
Email : info@fasngo.org
Website : http://www.fasngo.org
8 Rue du Vieux-Billard
P.O. Box 5037, 1211 Geneva, Switzerland

Don Fillinger
Secrétariat des Groupes de Genève
Amnesty International Geneva
Téléphone : 022 735 85 00
Fax : 022 700 51 46
9, avenue de la Gare-des-Eaux-Vives
1206 Genève
service@amnesty.ch
info@amnestygeneve.ch
(Did not respond)

Heidi Findlay
World Food Programme Geneva
Telephone: (+41 22) 917 85 68
Fax: (+41 22) 917 80 18
Email: heidi.findlay@wfp.org
International Environment House
11-13 Chemin des Anémones
CH-1219 Châtelaine (Geneva)
(Did not respond)

Oscar Fornoza
General Coordinator
International Centre for Trade and Sustainable Development (ICTSD)
Telephone: (+41 22) 917 84 92
Fax: (+41 22) 917 80 93
Email: ictsd@ictsd.ch

International Environment House 2
7 chemin de Balexert
CH-1219 Châtelaine (Geneva)
Website: www.ictsd.org
(Did not respond)

Fatma Gordon
Geneva Environment Network
Telephone: (+41 22) 917 8279
Fax: (+41 22) 797 34 64
Email: gen.secretary@unep.ch
International Environment House
11-13 chemin des Anémones
CH-1219 Châtelaine (Geneva)
Website: www.environmenthouse.ch
(Did not respond)

International Institute for Sustainable Development
Geneva office
Phone +41 22 917-8683
Fax +41 22 917-8054
E-mail: geneva@iisd.org
International Environment House 2
9 chemin de Balexert
1219 Châtelaine
Geneva Switzerland
(Did not respond)

Danielle Maillefer
Peacebuilding Point of Contact
Initiatives of Change International (IOFC)
Tel: +41 22 733 56 68
danielle.maillefer@caux.ch
P.O. Box 3 CH- 1211 Genève 20
http://www.iofc.org
(Did not respond)

Joanne Stutz
UNEP Post-Conflict and Disaster Management Branch
Tel: (+41 22) 917 85 30
Fax: (+41 22) 917 80 64
Email: joanne.stutz@unep.ch
International Environment House
11-13 chemin des Anémones
CH-1219 Châtelaine (Geneva)
Website: postconflict.unep.ch
(Did not respond)

Vicente Paolo B. Yu III
Programme Coordinator
Global Governance for Development Programme
South Centre
Tel.: 41 22 791 80 50, Fax.: 41 22 798 85 31
Email: yu@southcentre.org
URL: www.southcentre.org
Chemin du Champ d'Anier 17
Case Postale 228, 1211 Geneva 19, Switzerland

Research Locations

Anonymous ILO Interviewee's Home
72 Route du Boiron, Nyon

Femmes Africa Solidarite
8 Rue du Vieux-Billard
P.O. Box 5037, 1211 Geneva

Food for the Hungry
Dr-Alfred-Vincent 8
1201 Geneva

Home
Route du Boiron 21
1260 Nyon

International Environment House Library
15 Chemin des Anemones
1219 Chatelaine, Geneva

International Peace Bureau
41 rue de Zurich
1201 Geneva

South Center
Chemin du Champ d'Anier 17
Case Postale 228, 1211 Geneva 19

United Nations Library
Palais des Nations
1211 Geneva 10, Switzerland

Interactive Research Log

Interactive Research Log

Formal Interviews

Colin Archer
Secretary-General
International Peace Bureau
Tel: +41-22-731-6429, Fax: 738-9419
Email: secgen@ipb.org
www.ipb.org
41 rue de Zurich, 1201 Geneva, Switzerland.
Date: 21 October 2009
Duration: 1 hour
INTERACTIVE RESEARCH HOUR: 4 hours

Questions to frame the discussion:

- What are some of the environmentally sustainable development projects in Africa today?
- What are some ways to empower the local population?
- What are the major problems in Africa?
- How do you think we can help Africa?

Summary of Interview

Colin Archer talked about the different ways of empowering the local people in Africa. Some of the methods include the Grameen Bank credit system, empowering women by forming a support group, working with the local government, education, sustainable agriculture, and implementing projects that the local people would be able to adopt for themselves after Westerners leave. He gave me a lot of ideas on different sustainable development projects that people are organizing in Africa. He encouraged me to narrow down my topic, especially by looking into micro-financing and how that has become a sustainable project in Bangladesh. He also gave me contact information of many NGO's in Geneva that might be helpful to me.

Younis Ahmed
International Peace Bureau
Tel: 41 22 731 64 29, Fax: 738-9419
Email: Younis.ahmed@ipb.org
www.ipb.org
41 rue de Zurich, 1201 Geneva, Switzerland.
Date: 21 October 2009
Duration: 1 hour

INTERACTIVE RESEARCH HOUR: 4 hours

Questions to frame the discussion:

- How do you think we can empower the local African population?
- Do you think it is important to empower African women?
- What do you think is the biggest obstacle to African sustainable development?
- How do you think energy is playing a role in African security?

Summary of Interview:

Younis Ahmed thinks that one of the biggest problems in Africa right now is the corrupted government. He thinks that good governance is very crucial to development, especially to sustainable development. If the government is corrupt, then the economy, infrastructure, and living standard cannot grow. He thinks that energy is a very big issue in Africa, and right now it is fueling the corruption in Africa because the countries with oil are depending on rent. They are not developing their own infrastructure to become self sustainable. Thus, energy is creating more insecurity than security in Africa. In order to empower the local population, the government must not be corrupt, and each nation must have its own industries instead of being dependent on the international market.

Etienne Cadestin
Consultant
United Nations Environment Program
Economics and Trade Branch
Tel: 41 22 917 86 95
Email: Etienne.CADESTIN@unep.ch
15 Chemin des Anemones, 1219 Chatelaine, Geneva, Switzerland
Date: 28 October 2009
Duration: 1.5 hour
INTERACTIVE RESEARCH HOUR: 6 hours

Questions to frame the discussion:

- What do you think are some of the most effective means of capacity building?
- Can you talk about energy subsidies that have hurt the environment?
- What kinds of projects is UNEP pursuing in Africa right now?
- Do you come back to review a project's progress?
- Is UNEP doing anything to promote solar energy in Africa?
- Do you think it is possible to alleviate poverty in Africa but still be environmentally sustainable?
- Can you talk about how solar energy can help Africa's energy consumption become more sustainable?
- Can you talk about how solar energy use can be increased in Africa?

Summary of Interview

Etienne Cadestin recommended some books about sustainable development and poverty in Africa to me that I should read, including *The Bottom Billion* and *The White Man's Burden.* He thinks that in order to help Africa switch to solar energy, international organizations should give technical assistance to people and build a solid institutional background before injecting money into the continent. They should teach the local population to adopt solar energy instead of imposing Western ideas and expect them to just accept everything. Also, empowering women could greatly help with solar energy because they are the ones who stay in the home. He mentioned the Women's Federation who is working in India and Bangladesh and offering them micro-credit. He believes that environmentally friendly policies and development policies can be complimentary, but we need to get the government to invest in the right places. He also introduced me to his friend who worked in the UNDP who might be able to help me with my research.

Roger Zurcher
Food for the Hungry
Tel: 41 022 755 35 75
Email: rzurcher@fhsuisse.org
fhsuisse.org
Dr-Alfred-Vincent 8, 1201 Geneva, Switzerland
Date: 5 November 2009
Duration: 1.5 hours
INTERACTIVE RESEARCH HOUR: 6 hours

Questions to frame the discussion:

- What do you think is the most effective/important way to reduce poverty?
- What are some of the projects that have worked? Why?
- What are some of your projects that have failed? Why?
- Do many of your projects cooperate with the local population?
- How important do you think it is to empower the female population?
- What do you think is stopping Africa from developing?
- Why do you think that Africa has not adopted solar energy yet?
- How can we expand solar energy use in Africa?
- Is FH doing any in particular to promote solar energy in Africa?

Summary of Interview

Roger Zurcher talked a little bit about what Food for the Hungry does. It used to be a food aid organization, but has now transitioned to sustainable development promoter. FH does a lot of work with the agricultural sector and encouraging good, self-sufficient farming and helping the farmers acquire materials such as seeds, fertilizer, and farming supplies. He thinks that the most difficult problem in Africa is wars and conflicts. A region can have corruption and still develop, but if it has conflicts then any progress it

has made will be destroyed. It is better to work with the local government as opposed to the central government because the local government has less bureaucracy and corruption, and people know each other so it is easier to work. It is very important to empower women because once they are enlightened to the fact that they can have an effect, they make a lot of difference. The problem with donors is that there is usually a lot of discordance between donor's wants and the actual need of the area. He thinks that solar energy has been difficult in Africa because of all the conflicts that have taken place, leading to no infrastructure. The grid system only exists in some places, so most people do not have and are used to not having electricity. The Grameen Bank system is difficult to start in Africa because the poorest of the poor cannot access the credit because the regulations/criteria are too high for them. FH is not directly involved with solar energy because it is more focused with local agriculture.

Coumba Fall
Representative: PanAfrican, Centre for Gender, Peace and Development
Femmes Africa Solidarite
International Secretariat
Tel: 41 22 328 80 50, Fax : 41 22 328 80 52
Email : info@fasngo.org
Website : http://www.fasngo.org
8 Rue du Vieux-Billard
P.O. Box 5037, 1211 Geneva, Switzerland
Date: 9 November 2009
Duration: 1.5 hours
INTERACTIVE RESEARCH HOUR: 6 hours

Questions to frame the discussion:

- What do you think is the most effective way to empower women in Africa?
- What do you think is the most effective way to achieve sustainable development in Africa?
- Which do you think is more effective: top-down or bottom-up initiatives?
- How feasible do you think it is for Africa to adopt solar energy?
- How do you think women can help with solar energy in Africa?
- Why do you think Africa has not adopted solar energy yet?
- How do you think solar energy will be able to improve people's lives?

Summary of Interview:

Coumba Fall thinks that the best way to empower women is to empower them economically and get them involved in all regions of life, such as politics, economics, and social spheres. They need to be visible when there is no conflict so that they can contribute when there is conflict. It is very important to empower women because women have more of a direct effect on the family. They take care of the household, the children, and the interactive life between families. Therefore, if women are empowered, then they can more promptly improve the condition of their home.

Women are also very crucial to society because they have more negotiation and diplomatic skills than men. Women are also good for reconstruction because they know what the urgent issues are, and they go directly for the key issues, such as resetting the education system and tending to children's needs. Therefore, when it comes to solar energy, women would be a great vessel to deliver the technology to people's homes. It is also important to empower them economically. Solar energy can be very useful by giving women skills and make them small entrepreneurs. Having some capital and skills will improve their lives because right now, African women have one of the worst living conditions in the world. Many spend hours gathering fuel or wood, cooking, or fetching water for the family. The problem with Africa is that conflicts really destroy any sustainable progress that has taken place, and conflict from one place not only affects that place but all the surrounding areas, too. For example, the genocide in Rwanda has destroyed any progress Rwanda had made prior to the period. Africa has not adopted solar energy yet because of the many conflicts that break out very frequently across the continent. Reform should be bottom up because then the people can actually see the effects and the benefits of the project, and they will support it more. The micro-credit system that we see now must be reformed because some people are corrupting the system. Solar energy can help improve people's lives by saving them money on kerosene, help their health because they do not have to burn toxic fuel, and help children study later at night.

Anonymous
Retired Principal Counselor of the ILO to UNDP
International Labor Organization
Tel: 41 22 361 98 52
72 Route du Boiron, Nyon, Switzerland
Date: 9 November 2009
Duration: 1 Hour
INTERACTIVE RESEARCH HOUR: 4 Hours

Questions to frame the discussion:

- Why do you think Africa has not developed despite all the aid we have given them?
- How do you think we can help Africa?
- How do you think solar energy can help Africa?
- Why do you think solar energy has not become more popular in Africa before?
- Do you think the ILO has been effective in raising work standards in Africa?

Summary of Interview:

This speaker thinks that the problem with Africa's development was that it met Western forces when it was too underdeveloped. This speaker thinks that Africa is still not independent because it still depends heavily on foreign aid and cannot sustain itself. The West wants Africa to give up its culture, but this causes resistance. The ILO's policies that have been implemented have had some effect, but the effects have only been short term, and there has been no real change. ILO and other international

organizations, such as the IMF and the World Bank, are controlled by Westerners who do not really know the conditions in Africa. The international organizations say that they are changing their ways, but they cannot truly change their working method because of the restrictions that these organizations have from their donors. Africa must develop at its own pace. Globalization is a good force, and opening up to Western culture can be a good thing, but the people must be allowed to accept what they are willing to accept instead of being forced to accept them. Solar energy can make people's living standards better because people will have more electricity and can use electrical appliances, which can help them with lighting and cooking. Solar energy has not become more widespread in Africa because the country is just too poor. Most people cannot afford this technology. The government needs to help the African people by subsidizing their helpful projects and encouraging people to make smart choices. The work that the ILO has done in Africa is, once again, only temporary, and there really has not been a true change in the conditions of Africa. This speaker had a cynical view of all of the effort that the different international organizations have made, which is very different from the views of my other interviews.

Avani Dixit
Disaster Reduction and Recovery Team
United Nations Development Program
avani.dixit@undp.org
15 Chemin des Anemones, 1219 Chatelaine, Geneva, Switzerland
Date: 10 November 2009
Duration: 1 Hour
INTERACTIVE RESEARCH HOUR: 4 Hours

Questions to frame the discussion:

- Can you talk a little bit about what you do in your department?
- What efforts is UNDP making to empower the local community?
- Do you try to incorporate environmental aspects when designing your programs?
- Do you try to encourage sustainable energy usage in your programs?
- Do you try to encourage solar energy use when making your post disaster risk assessments?
- Do you think development is more effective top-down or bottom-up?

Summary of Interview:

The UNDP works with seven pillars: climate risk management, disaster risk assessment, urban risk management, main streaming, capacity building, gender, and recovery. There is a set of procedures for reassessing progress, but sometimes people do not completely follow the procedures. The problem with the UN is that there is a lot of hierarchy, bureaucracy, a high turnover rate so there is not a lot of continuity, and they must meet donors' criteria. The main focuses of the UNDP projects are capacity building and to train the officers to keep the projects running. UNDP does take environmental factors into account when designing a program, including sustainable energy usage. Solar energy is difficult to implement in Africa because there is widespread corruption,

and it lacks infrastructure. It is very costly to start a widespread energy program, and it is especially difficult to have a corrupt government invest in such a project. Development should be both top-down and bottom-up, and then meet in the middle. Top-down reforms have very slow effects on the lower tiers of society, and bottom up reforms do not yield enough result. Both reforms are necessary to have a stable and prosperous nation. Working with a decentralized government is much easier, but the UNDP can only work with the national governments and regional officers.

Vicente Paolo B. Yu III
Programme Coordinator
Global Governance for Development Programme
South Centre
Tel.: 41 22 791 80 50, Fax.: 41 22 798 85 31
Email: yu@southcentre.org
URL: www.southcentre.org
Chemin du Champ d'Anier 17
Case Postale 228, 1211 Geneva 19, Switzerland
Date: 16 November 2009
Duration: 1 Hour
INTERACTIVE RESEARCH HOUR: 4 Hours

Questions to frame the discussion:

- What kinds of solar energy systems are available in Africa?
- Why do you think solar panels are not very widespread in Africa if it is so beneficial?
- What are some of the benefits of installing a solar panel electric system?
- What are the difficulties with installing such a system in Africa?
- What are some of the feasible ways to make their use more widespread?
- What do you think is the feasibility of harnessing the solar power of the Sahara Desert for Europe's energy needs?
- How do you think installing a solar panel system will change the lives of African people?

Summary of Interview:

Africa nation's major challenge is its power void after it gained independence. African states are very big and include many different ethnic groups, leading to political tension and weak governance. Africa needs a functional political identity to build up its economy, and Sub-Saharan African countries are starting to become more stabilized. Solar energy has not been widespread in Africa because there is not enough economic viability and infrastructure. There is no human or technological resource to make solar energy sustainable. Solar panels work best in a decentralized manner. Africa has a lot of sunlight, but other factors are not present to sustain this technology. The technology that is imported into Africa is usually not suitable for the African environment, such as the Danish windmills that kept on breaking down because of sand storms. The

technology used in Africa must be adapted to its location and cannot simply be imported from other nations. Bringing solar energy from Africa to Europe will be very difficult because many cables must be built. Solar panels cannot be used in this system because solar panels do not work well in a grid system, and a lot of energy will be lost in the transfer. Europe should focus on hydropower plants because it has a lot of waterways. It is important to introduce something into a community that it thinks it needs because then the locals will make it their own. Traditional farming communities may not even need electricity because they do not have electrical appliances, or their lifestyles are based around no electricity. If an intervention is to be effective, you must consider what factors are missing so that the technology can really be effective. Maybe the answer is to introduce solar appliances, instead of solar energy systems, because in this way, African people can directly use the energy. People must be careful to not introduce things that will cause social dissonance, because some concepts and technology do not blend well with the local culture.

Informal Interview

Derek Christie
Association Transports et Environnement Section de Geneve
World Health Organization
Email: ate.geneva@bluewin.ch
Date: 12 November 2009
Duration: 1 Hour
INTERACTIVE RESEARCH HOUR: 1 Hour

Questions to frame the discussion:

- How do you think solar energy will change the way transportation is right now?
- Do you think Africa will be able to switch to solar energy soon, given that it has an abundance of sunlight?
- How do you think solar energy will be helpful for the environment?

Summary of Interview:

Solar energy will mean that electricity is much easier to make, which will probably mean that there will be more electrical cars. Derek Christie is surprised, though, that electric cars are not very prevalent even though they have been around for a long time. Perhaps this is because it is still inconvenient now to recharge the cars, because the cars are still slow, or because there has not been enough investment and promotion of electric cars. A major problem is that it is still cheaper to use conventional forms of energy, such as oil, than it is to make the radical switch to a whole new form of energy. Solar energy will be very helpful because it is abundant, unlimited, and does not harm the atmosphere.