



The African Union

Topic B: Clean Energy Generation

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8 April 2010



# Clean Energy Generation

## Introduction

The world relies on the combustion of materials, largely fossil fuels, for energy. The main drawback to these sources is the carbon dioxide (CO<sub>2</sub>) they emit to the atmosphere. CO<sub>2</sub> is considered a “greenhouse gas,” a gas that traps heat in the atmosphere, which contributes to climate change. Climate change may lead not only to higher temperatures but changes in sea levels and rainfall.

In Africa, the main energy sources can be divided by region. North Africa relies on oil and gas for energy while South Africa mainly utilizes gas, and Sub-Saharan depends heavily on biomass energy<sup>1</sup>. Biomass energy is defined as organic sources such as wood, animal waste, charcoal, etc<sup>1</sup>. This energy source, though readily available and affordable, is harmful to the environment; the pollution from biomass energy is estimated to cause 1.6 million premature deaths due to respiratory illnesses<sup>2</sup>. Even in countries where fossil fuels are readily available such as Nigeria, biomass is still overwhelmingly the main source of energy. With the rapid urbanization of many African cities, the reliance on biomass energy sources is predicted to only increase.

The prolonged and increased use of biomass energy will contribute to climate change. While Africa’s CO<sub>2</sub> emissions are relatively low compared to emissions from industrialized countries, climate change is predicted to disproportionately impact Africa. In fact, the effects of global warming can already be seen on the continent. Glaciers on Mount Kilimanjaro have shrunk by

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<sup>1</sup> Karekezi, Stephen, and Waeni Kithyoma. "Renewable Energy in Africa: Prospects and Limits." 4 June 2003.

<sup>2</sup> Myron, Kevin. "Benefits of clean fuel in Africa would be enormous." *Harvard Gazette*, April 7, 2005.



70% in the past century<sup>3</sup>. Unpredictable rain patterns, which have resulted in flooding in southern Africa while East Africa suffers from drought, adversely affect the rain-dependent agriculture industry, on which 70% of the population relies<sup>iii</sup>. As temperatures and rain patterns continue to change, the amount of land available for farming and livestock production will be reduced<sup>1</sup>. At the same time, warmer temperatures and higher sea levels will expand habitats for disease-carrying organisms such as mosquitoes<sup>iii</sup>. Despite the impending and current effects of climate change, the African Union has not developed a uniform position on clean energy generation. The Kyoto Protocol of 1997, an international treaty signed by 184 countries, addresses the issue of global warming. The treaty was signed by the majority of African countries and features caps on greenhouse emissions for developed countries. The world's leaders convened in Copenhagen in December 2009 to once again discuss how to address climate change and develop an agreement that will replace the Kyoto Protocol.

The positive effects of clean energy are enormous. A recent study from Harvard University found that by transitioning to cleaner charcoal energy, Africa can reduce greenhouse emissions by 45 to 66 percent and prevent 2.8 million deaths<sup>ii</sup>. Clean energy can also provide more reliable energy sources and job opportunities. However, a lack of infrastructure, high costs, and a lack of tangible policy commitments and investment have prevented Renewable Energy Technology (RET) and other forms of clean energy generation from becoming a reality. The lack of people with technical knowledge, such as engineers to operate RETs, is also lacking, raising the concern that there will not be enough operators to run the energy sources even if they are built. Still, economists and many analysts see a great opportunity to build RETs and other clean energy source in Africa; since many

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<sup>3</sup> "AFRICA ENVIRONMENT OUTLOOK." *United Nations Environment Programme*.  
<http://www.unep.org/dewa/Africa/publications/aeo-1/034.htm>.



countries in Africa have limited power sources, replacing them would theoretically be easier to accomplish than in many industrialized countries.

### Background

While developing countries stand in greatest danger of climate change and have the most to gain by addressing it effectively, the blame, and the onus for finding a solution, often seems to lie solely with developed countries. A consensus among developing countries is that developed countries are polluting too much, or at least that they are being irresponsible with their energy consumption. But what is too much pollution? What kinds of energy creation are considered “clean”? What is “dirty” energy generation? The vast majority of African nations are classified as part of the developing world, which means they have very little financial capital to spend on creating new means of energy generation or invest in developing cleaner ways to use the energy sources they already possess.

For African countries that possess large reserves of oil--Nigeria, Angola, and Libya, to name several--it serves as an important resource, both economically and as a source of fuel. Fossil fuels (coal, oil, and natural gas) are certainly used for fuel, but are also used to create plastics and other consumer goods the developed world uses every day. However, the manufacture of these products, and the burning of fossil fuels to power everything from cars to industrial plants, releases large amounts of carbon dioxide into the atmosphere, which most scientists believe has been the primary cause of climate change since the Industrial Revolution.

Coal, still used in the developed world, is a major source of fuel for many countries, especially in southern Africa. Coal is a highly combustible type of rock mostly made of carbon, and



has historically been used to fuel things smelting furnaces and locomotives. While it is not largely used as transportation fuel anymore, it is still widely utilized for electricity generation, which in and of itself expels a large amount of carbon dioxide into the atmosphere. The method of extraction for coal is also a threat to the environment. Strip mining, or open pit mining, in which the layer of topsoil and other rock above the coal bed is stripped away, is much cheaper than traditional mining practices in which tunnels are built and coal taken from the mines in carts and is thus much more widely used in Africa, but also generates significantly more pollution.

An idea that has recently gained popularity--especially in American media--is “clean coal.” The idea of clean coal is that once the carbon dioxide created by the burning of coal is created, it is sequestered underground so as not to inflict damage upon the atmosphere. However, there are as yet few tests of the effectiveness of such methods. Many in the scientific community scoff at the label “clean coal,” on the premise that any burning of a fossil fuel is inherently hazardous to the environment.

The challenge today is to create methods of energy generation that do not use fossil fuels, but are as economically advantageous as fossil fuels. There are plenty of options for clean energy: solar, wind, and hydroelectric are among the most frequently discussed. Each clean energy generation method has advantages and disadvantages.

Hydrogen technology, easily one of the most controversial of the clean energy alternatives, has proven viable from a scientific standpoint, at least on a small scale. The first automobile powered by a hydrogen cell was made by General Motors in 1966, and countless other vehicles have been made to run on them since that time. The problem has simply been one of cost. Although



hydrogen is the most abundant element in the universe, creating a fuel cell from it is not cost-effective at present.

Solar power has gained popularity in recent years as an efficient use of an abundant resource. Solar energy can be harnessed either to generate electricity directly or to heat water, the enthalpy from which can be turned into an electric current. For a community with small energy needs, solar power can be an adequate solution.

But the sun does not shine all the time. In order for solar energy to provide all that is necessary to a house or community, a generator must be purchased to store energy during clear weather, so that it can be used at night or during overcast weather. This use of generators depends on there being excess electricity generation, demanding judicious use of electricity and making solar power a less-than-ideal solution on the large scale.

One of the oldest forms of energy generation is wind power. It has been used for centuries to create electricity or power grain mills. While wind turbines, usually located on wind farms or the like, are useful in creating energy, they must be placed in locations where the majority of days receive wind, and the average wind speed is high enough to make the building of the turbines economically efficient. In addition, the turbines used to generate electricity typically require the use of fossil fuels to operate, which presents a contradiction to the idea that wind is a clean energy source. It should be noted that the amount of fossil fuel used in wind generation is significantly smaller than that used with coal or natural gas to create the same amount of energy.

Hydroelectricity is the most widely used form of clean energy today. It accounts for almost 90% of the world's renewable energy and roughly 20% of total energy generation. Some of the largest hydroelectric projects are China's Three Gorges Dam, Brazil's Itaipu power plant, and



Egypt's al-Aswan Dam. While hydroelectricity is an efficient use of natural resources, many environmentalists have argued that the environmental impact of creating these dams is too high. Dams affect the ecosystem of the river in which they are placed, can interfere with the breeding patterns of marine life, and create large reservoirs where none existed before. Silt can also build up behind the dams, which in the case of al-Aswan was historically used to create more arable land in the Nile Delta.

No clean energy is perfect. Each method of power generation has its drawbacks, but hardly any expert would argue that with the varied ways of creating clean energy, a method that is most beneficial to any community cannot be found.

### Current Status

The continent of Africa is endowed with a wide variety of natural energy resources, including crude oil, natural gas, coal, uranium, tar sand, hydro-electricity, geothermal energy sources, biomass, and abundant sunshine and wind across large areas. In African generally and Sub-Sahara particularly, however, the use of "modern" energy sources like electricity and fossil fuels is still relatively insignificant, due to limited access to grid electricity. About 30% of the region's population, and less than 8% in rural areas, have access to electricity, making economic development almost impossible.

Energy production in Africa is spread out unevenly amongst the African countries due to the limited availability of resources. In 2003, Africa produced 11% of the world's crude oil, with 85% of that originating in four countries, Nigeria, Algeria, Libya and Egypt. Likewise, Africa accounts for



5% of the world's coal production; however, South Africa alone contributes 97% of Africa's total coal output.

Blackouts are a routine occurrence in West African countries due to the poor infrastructure and maintenance of power plants and generators. The majority of these power plants were built in the 1950s and 1960s, and a dearth of investment to improve or maintain these structures has led them to become completely unreliable and perpetually broken. Nigeria, for example, is operating at only one-third of its total capacity due to faulty and aging equipment.

War and strife is, of course, a common occurrence in Africa and has left the continent devoid of any infrastructure to maintain energy generation. Long civil wars in Liberia have damaged key generation and distribution infrastructure, costing the national electricity company over \$100 million to fix over a period of five years. In Sierra Leone, the Bumbuna hydroelectric project was nearly complete when civil war broke out, disrupting and destroying parts of the construction.

Africa can be divided up into three distinct regions in regards to energy consumption. North Africa is dependent on oil and southern Africa relies heavily on coal. In Sub-Saharan Africa, however, due to low levels of investment spending, infrastructure, and overall development, two-thirds of all energy consumption, and up to 95% in some countries, comes from highly inefficient traditional biomass. Per capita energy consumption in North and Southern Africa dwarfs that of Sub-Sahara; South Africa has one-tenth as many people as Sub-Sahara but uses three times as much electricity. North Africa consumes six times as much gas as sub-Saharan Africa, showing the clear disparity in wealth and energy availability throughout Africa.

The effects of the use of traditional biomass fuels, especially in sub-Saharan Africa, are devastating to the local environment. The use of these types of fuels, particularly wood and charcoal,



leads to deforestation and degradation of the environment due to increased soil erosion and flooding.

The common activity of cooking food using fuel wood is a practice that is prevalent in rural areas in Sub-Saharan Africa. This seemingly insignificant activity can lead to major local and regional air pollution when multiplied by the thousands of people who rely on wood for this purpose. Additionally, the necessity for gathering this fuel wood leads to increased clearing of land for agricultural development and timber, causing deforestation. Scarcity of wood causes families to utilize other agricultural residues and animal dung for cooking. This alternative use of natural fertilizers for fuel leads to lower soil fertility and increased soil erosion because these residues are not getting ploughed back into the fields. Charcoal is another unsustainable biomass fuel that is heavily used in sub-Saharan Africa. It is inefficient as a fuel and directly leads to increased deforestation and destruction of land because it is produced from forest resources. The destruction of the environment due to the widespread use of biomass fuels increases the difficulty of economic and social development because there are not plentiful alternative resources available.

Africa does have the potential to produce clean energy through the diverse natural resources that are abundant throughout Africa. For example, Africa possesses some of the best rivers in the world for hydroelectric generation, including the Nile, the Congo, the Niger, the Volta, and the Zambezi. A startling example of this untapped potential can be seen in the specific case of the Democratic Republic of Congo, which is estimated to have the capacity to produce energy equivalent to three times Africa's current consumption through hydroelectric power alone.

Other forms of renewable energy are waiting to be harnessed in Africa because, although many regions do not have a climate conducive to agriculture, Africa is plentiful in natural resources,



making it a prime location to begin the trend of complete switch to clean energy. This could be achieved through solar power, wind power, geothermal energy, and hydroelectricity.

### Question to Consider

1. What are the cost comparisons between traditional energy generation and new methods of clean energy generation?
2. What existing governmental programs exist to encourage clean energy generation?
3. What programs or economic incentives have worked in other countries that are applicable to Africa?
4. On what scale can any given African country expect to reasonably reduce dirty emissions, and within what time frame could these reductions be made?
5. What work have international bodies done to incentivize clean energy in developing nations?
6. What assistance has been provided by Group of Eight countries, and what assistance would be necessary to further the aims of this committee?
7. How much of an impact could African compliance with Copenhagen agreements be reasonably expected to have in reducing overall carbon emissions?

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