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Energy Production, Consumption, and Corruption in Sub-Sahara Africa's Infrastructure Projects

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Abstract: The World Bank and other development banks regularly fund major energy projects to restore and improve aging infrastructure systems in African countries. Energy is arguably the most important form of infrastructure in all economies, developing, emerging, or advanced. Through energy all other forms of infrastructure are created, developed, or enhanced. However, when energy production significantly exceeds energy consumption, situations are created for opportunistic persons more interested in improving their financial well-being than in managing an infrastructure project in an ethically and morally acceptable manner to capitalize. This paper investigates infrastructure development within the energy sector in six Sub-Sahara African countries; namely Botswana, Lesotho, Mozambique, South Africa, Swaziland, and Zimbabwe. The objective is to determine the relationship between energy production, consumption, and corruption. Several relationships were found to be significant at the 0.05 and 0.10 alpha levels, offering insight into the potential affect that corruption may have on the energy sector in Sub-Sahara Africa. This study will better enable and align the North American contractors who implement infrastructure projects in these countries develop effective and efficient management strategies that match the unique characteristics governing operations of such energy sectors.

1. Introduction

Energy is arguably the most important form of infrastructure in all economies, developing, emerging, or advanced. Through energy all other forms of infrastructure are created, developed, or enhanced. Agricultural products are planted and harvested, potable water is distributed, municipal solid wastes are managed, roads and highways are constructed, airports and harbors are developed, and even power plants themselves, are made possible – all through the various forms of energy. However, when energy production significantly exceeds energy consumption, situations are created for opportunistic persons more interested in improving their financial well-being than in managing an infrastructure project in an ethically and morally acceptable manner to capitalize.

Giorgis (2010) stated, "*About fifty years after the end of the colonial era, the prototype postcolonial African state remains weak and lacking in legitimacy, delivery and relevance … Despite its considerable resource endowment, Africa continues to barely subsist at the periphery of the global economy and to cling to the margins of general world affairs … Monopoly on political power and economic resources in the hands of small minorities, brutal state repression and lack of rapid, sustained and balanced development have driven the majority of African people into the quagmire of widespread misery, worsening deprivation and deepening despair … The pervasive malaise troubling Africa today is primarily a function of the chronic deficit in democratic governance, widespread economic mismanagement and*

rampant corruption that operate to undermine nation building, undercut state construction, hinder national development and vitiate state fragility". Arguments such as these have triggered the World Bank and other development banks to fund major infrastructure projects in the region in an effort of restoring and improving the aging infrastructure systems in various African countries.

The World Bank was created at the Bretton Woods Conference, USA, in 1944. It was established to carry out the reconstruction works in Europe after World War II. Later, its mission was changed to reduce poverty through funding various infrastructure projects in developing countries. Currently, the World Bank is based in Washington, D.C. and has 187 member countries. The World Bank provides over $24 billion for activities in developing countries every year (World Bank 2010). The World Bank Group is comprised of five institutions; International Bank for Reconstruction and Development (IBRD), International Development Association (IDA), International Finance Corporation (IFC), Multilateral Investment Guarantee Agency (MIGA), and the International Center for Settlement of Investment Disputes (ICSID). The first two institutions, IBRD and IDA, work primarily with governments; their work is complemented by the other three institution to provide low-interest loans, interest-free credits, and grants to developing countries for a wide range of purposes that include investments in education, health, public administration, and infrastructure (World Bank 2010). The activity of international contractors in Africa increased at an average annual rate of 15.4% in recent years (Chen and Orr 2009).

According to Jaselskis and Talukhaba (1998), governments in developing African countries directly influence the public and private constructions sector by setting the rules for development and contractual relationships. To this end, no habitable continent is exempt from corruption, nor is any country. Of the countries considered most corrupt by Transparency International, corruption in 30 of those countries is considered 'rampant' and it is considered 'serious' in 14 other countries (Clarke 2011). While African countries have made improvements in dealing with corruption over the last 10 years, costs associated with corruption across the African continent remain high. Corruption in Africa is estimated to cost USD150 billion annually, while in contrast, countries in Sub-Sahara Africa received USD22.5 billion in aid from advanced economies in 2008 (Hanson 2009).

2. Goals and Objectives

This paper examines infrastructure development within the energy sector in six Sub-Sahara African countries; namely Botswana, Lesotho, Mozambique, South Africa, Swaziland, and Zimbabwe. The objective is to determine the relationship between energy production, consumption, and corruption. This research will better enable U.S contractors who implement infrastructure development projects in these countries to develop effective and efficient management strategies that match the unique characteristics governing operations of such energy sectors.

3. Background Information

3.1 Energy and Energy Sectors in Sub-Sahara Africa

Energy is a pressing issue in the world economy, regardless of the country. The United States Energy Information Administration (USEIA), an agency that provides independent statistical analyses of the world's energy production and consumption, predicts energy consumption to rise drastically through 2035 (International Energy Outlook 2011). To this end, Figure 1, below, depicts world energy consumption through 2035 for nations associated with, and nations not associated with, the Organization for Economic Cooperation and Development (OECD). USEIA has forecasted a 15.1 percent increase in energy consumption from 2015 through 2035 for OECD nations, and a 49.1 percent increase over the same 20 year period for non-OECD nations. Combining OECD nations with Non-OECD nations, USEIA has predicted a 196.3 QBTU increase (34.2%) in energy consumption. Africa is no different; increased energy production comes with economic growth, though not necessarily with population growth.

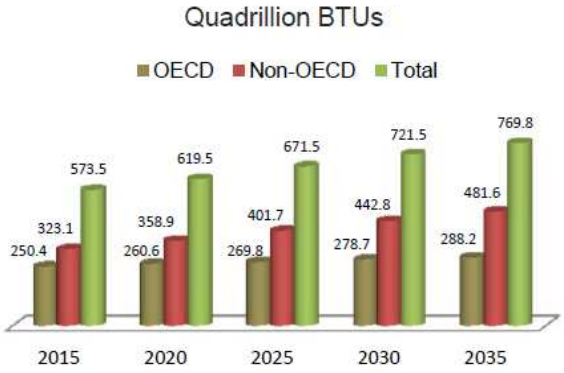

Figure 1: World Energy Consumption

For example, in the Kingdom of Swaziland; the generation, transmission, and distribution of electricity are managed by Swaziland Electricity Company (SEC) in Mbabane. SEC itself currently meets around 15 percent of production. Consequently, most of the electricity consumed in Swaziland is purchased from neighboring South Africa through Eskom; and Mozambique through Electricidade de Mocambique (EDM) (Swaziland Electricity Company 2011). As a paralleling note of interest, EDM plans to invest over one billion dollars over the next few years to improve generation capacities in Mozambique (AfriElectric 2011), and Eskom recently announced that it intends to double its generating capacity by 2026, to 80,000MW (Eskom, 2011). In addition, Eskom recently announced receipt of a USD365 million loan from the Africa Development Bank to implement solar and wind energy projects throughout South Africa (African Development Bank 2011). Swaziland currently operates at an 85 percent deficit in terms of its ability to meet electricity production. This places Swaziland's production at 403MW, leaving significant room for the expansion of energy projects. Specifically, it places Swaziland operating at a 343MW deficit currently, with deficits between consumption and production to increase to 850MW over the next 25 years (Xicon Infrastructure 2011).

Like SEC in Swaziland, publically owned energy companies have dominated the African energy market over the last several decades (Turkon 2001). However, in more recent years many energy companies have incorporated the private sector into the industry (Auriol and Blanc 2009), be it generation, transmission, or distribution. For example, as this study is conducted, the Federal Republic of Nigeria is privatizing its energy sector, with the Republic's relatively new president, Dr. Goodluck Ebele Jonathan, GCFR, fully supporting the project. The first round of the bidding process for the transfer has been completed, and companies that were pre-qualified by the Power Holding Company of Nigeria (PHCN), the initial holding company for the transfer, have been invited to move to the next phase of bidding (The Presidency of the Federal Republic of Nigeria 2010). PHCN is transferring ownership of the following plants, grids, and companies to a private investor as shown below in Table 2.

One of the driving factors associated with privatizing the energy sector in Nigeria is an energy production that significantly exceeds energy consumption. To meet the difference between consumption and production, energy experts in Nigeria have set a goal for the country having a generating capacity of 40,000MW by 2020, and endeavor that is estimated to cost USD3.5 billion per annum for 10 years – totaling approximately USD35 billion (The Presidency of the Federal Republic of Nigeria, 2010). Over 100 energy companies, or partnerships, are competing to secure this project and ultimately deliver the 40,000MW of electricity.

Other countries in Sub-Sahara Africa have, or are considering, privatizing their energy sectors, as well. The city of Mbabane in the Kingdom of Swaziland is currently implementing a new Waste to Energy (WTE) plant that will utilize a hybrid fuel system that incorporates municipal solid wastes (MSW) as well as coal or gas. Such an implementation will significantly increase energy consumption in a country where energy production is currently met by foreign corporations, primarily Eskom in South Africa and Electricidade de Moçambique in Mozambique (Xicon Infrastructure, 2011). Along with Nigeria and Swaziland, several other countries are modernizing their energy sectors, such as Angola, making their energy sectors a potentially appealing investment for foreign infrastructure investors (United States Trade

and Development Agency, 2010); the Ministry of Energy in Angola is also currently considering the technical, economic, and financial feasibilities of pursuing a multi-year energy endeavour.

Foreign direct investment in the energy sector in Sub-Sahara Africa can be beneficial not only in promoting economic growth, but in meeting *current* energy production. However, the influx of foreign investments as a means of privatizing energy sectors in the African market has the potential of creating environments that exasperate corruption among both the private and public sectors. Of course, this potential holds true in every country, not just those in Africa.

3.2 Basic Infrastructure in Sub-Sahara Africa

Energy is often considered a necessity for economic development, and economic development most often only comes through job creation. For all but one of the countries considered in this study, unemployment rates are substantially high. For example, nearly the entire country of Zimbabwe is unemployed (95%). More telling, while South Africa is thought to be more developed than most African nations, the unemployment rate is still high (21%). Unfortunately, substantial economic growth will not occur in developing countries without adequate infrastructure, and only the country of Botswana currently has an unemployment rate conducive to substantial economic development (Xicon Infrastrucure, Research Group 2011). These facts can be better interpreted from Figure 2, below.

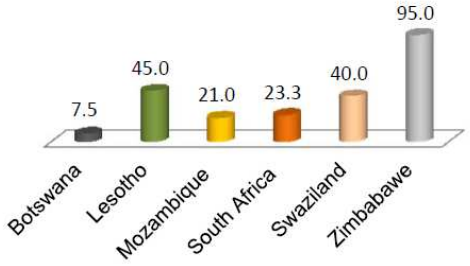

Figure 2: Unemployment Rate (Percentage of Population) in Sub-Sahara Africa

Along with energy, adequate transportation systems also contribute to economic development (Xicon Infrastrucure, Research Group, 2011). Of the six participating countries in this study, Botswana has more highways and roads, measured in kilometers per capita, than any other nation, followed by Zimbabwe and South Africa. Mozambique has less highways and roads than the other five countries in the study. These facts can be better interpreted from Figure 3, below.

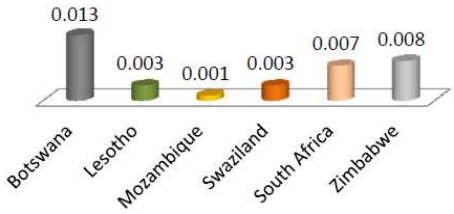

Figure 3: Road Length per Capita in Sub-Sahara Africa

In addition to energy and transportation, adequate water and sanitation also contribute to economic development (Xicon Infrastrucure, Research Group, 2011). Access to improved water supplies and sanitation facilities has increased in recent years for all six countries in this study. Populations with access to improved water supply and sanitation facilities are noted below in Figures 4 and 5, respectively.

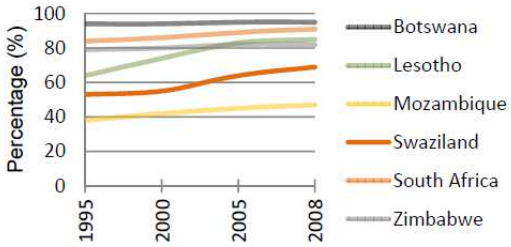

Figure 4: Population with Access to Improved Water Resources

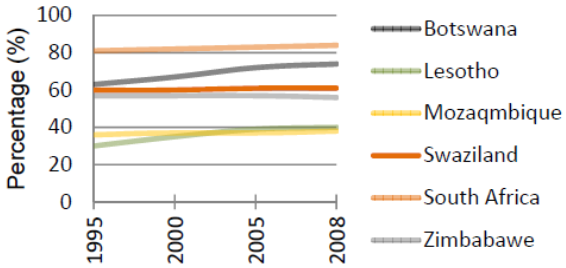

Figure 5: Urban Population with Access to Improved Sanitation

3.3 Infrastructure Projects and Corruption in Sub-Sahara Africa

Transparency International conceptualizes corruption as the misuse of power for personal gain, while other researchers define corruption as unethical or immoral behavior that may, or may not, be considered illegal (Habtemichael and Cloete 2010). As such, delineating the ambiguities associated with actually defining corruption over every country and forming a universally accepted definition comes with inherent difficulties. Corruption is comparable to a social virus that continuously adapts to its environment. When anti-corruption strategies are incorporated into a system, or environment, to control or eliminate such activities, the means and methods necessary for corruption adapts to endure. One cannot eradicate corruption; at best, corruption can only be curbed by reducing its intensity (Habtemichael & Cloete, 2010) to a manageable level. To this end, Habtemmichael and Cloete (2010) characterize corruption using complexity thinking – defined as the study of complex adaptive systems. Complexity thinking encompasses various forms of systems theory, primarily chaos theory and fractal geometry. Habtemmichael and Cloete (2010) further postulate that one must view corruption through complexity thinking to understand its fundamental characteristics. More specifically, they propose that since the world, and all it involves, is intrinsically holistic in nature, that corruption itself can only be understood through holistic approaches. Though not emphatically stated by Habtemmichael and Cloete (2010), they offer substantiation of their use of complexity thinking, noting that in studying corruption one notes that corruption evolves simultaneously with the development of economies. More simply, they concluded that as economies are fostered and develop, corruption is not eliminated, or even necessarily diminished; corruption simply evolves. Finally, Habtemmichael and Cloete (2010) categorized corruption into four overlapping groups they call approaches. These approaches, along with brief definitions or explanations, include the following:

- Public office centered approach, occurs when behavior deviates from normally accepted rules of public office;
- Public interest centered approach, occurs when public officials are bribed at the expense of the public;
- Market centered approach, occurs when a public official considers himself an authority that can leverage his status for personal gain; and

- Public opinion approach, occurs when the dichotomous variables of ‘right’ and ‘wrong’ are derivatives of current public opinion.

In many areas of Africa, all four approaches appear to occur simultaneously. The socio-economic situation is such that services associated with infrastructure are often subsidized for the poor and middle classes, particularly as it relates to electricity. Subsidizing the cost of electricity to the poor and middle classes especially holds true with countries in eastern and southern Africa where it is still common for families to utilize wood resources as fuel for heating and cooking, especially for those families living in rural environments. However, services for the upper-middle and upper classes are provided by public or private utility companies (Auriol and Blanc 2009). Of course, the upper-middle and upper classes subsidize the poor and middle classes, and as such, have the abilities to control infrastructure, be it electricity, water, or sanitation – as such, offering evidence that a form of all four approaches occur regularly in Africa. Consequently, attracting and retaining foreign direct investment in Sub-Sahara Africa is problematic.

4. Methodology

In light of the aforementioned data, this research calculated correlation coefficients using Pearson’s Product Moment method to determine the relationships between energy production, energy consumption, and corruption. The authors utilized a two step methodology where: (1) energy data was collected through resources associated with the United States Central Intelligence Agency, Index Mundi, and the Ministries of Energy for each of the participating countries in this study. Data were collected and analyzed for years 2005-2011, and (2) corruption data was collected primarily through Transparency International, a European entity committed to revealing political corruption throughout the world. Specifically, corruption indices were collected and analyzed for years 2005-2011 through Transparency International’s Corruption Perceptions Index (Transparency International 2011-b).

The authors calculated the bivariate correlations using the Pearson product moment method to test for statistical significance of relationships. In accordance with Davis (1971), the Pearson equation is noted below where the correlation relationships were characterized as 0.70 or higher (very strong association), 0.50 to 0.69 (substantial association), 0.30 to 0.49 (moderate association), 0.20 to 0.29 (low association), and 0.01 to .019 (negligible association):

$$\rho_{xy} = \frac{\sum_{i=0}^{N-1}(x_i - \overline{x}) * (y_i - \overline{y})}{\sqrt{\sum_{i=0}^{N-1}(x_i - \overline{x})^2 * \sum_{i=0}^{N-1}(y_i - \overline{y})^2}} \quad (1)$$

To this end, correlation coefficients were calculated between energy production and energy consumption, energy production and corruption, and finally, energy consumption and corruption.

5. Results and Analysis

Table 1, below, shows the findings for each of the six countries in this study where several coefficients were found to be significant at the .05 and .10 alpha levels. Energy production increased with energy consumption in all countries in this study. In three of the six countries, the relationships between production and consumption were found to be statistically significant. The relationships between production and consumption were significant in Lesotho, Mozambique, and South Africa ($p<.01$, $p=.021$, and $p<.01$, respectfully). Also, three relationships between energy production and corruption were found to be significant at the .01 alpha level, including Botswana ($r=.767$, $p=.075$) and Lesotho ($r=.786$, $p=.064$). However, while the relationship between production and corruption was also significant at the .01 alpha level for Zimbabwe ($p=.062$), the relationship was inverse ($r=-.788$). In addition, and though not significant, the relationship between energy production and corruption in Mozambique was inverse (r=-

.455). Finally, the relationships between energy consumption and corruption was found to be significant at the .01 alpha level in Botswana (p=.059) and Lesotho (p=.070). There was no significant relationship between consumption and corruption in the other four countries in this study. However, as was the case between production and corruption, the relationship between consumption and corruption in Zimbabwe was inverse (r=-.403), though not significantly.

Table 1: Correlation of Energy Production, Consumption, and Corruption

Republic of Botswana

	Production	Consumption	Corruption
Production	1.000	-	-
Consumption	0.318	1.000	-
Corruption	*0.767	*-0.122	1.000

Note: Asterisk (**) and Red: Significant at the 0.05 alpha level.
Asterisk (*) and Red: Significant at the 0.10 alpha level.

Kingdom of Lesotho

	Production	Consumption	Corruption
Production	1.000	-	-
Consumption	**0.993	1.000	-
Corruption	*0.786	*0.778	1.000

Note: Asterisk (**) and Red: Significant at the 0.05 alpha level.
Asterisk (*) and Red: Significant at the 0.10 alpha level.

Republic of Mozambique

	Production	Consumption	Corruption
Production	1.000	-	-
Consumption	**0.880	1.000	-
Corruption	-0.455	-0.276	1.000

Note: Asterisk (**) and Red: Significant at the 0.05 alpha level.
Asterisk (*) and Red: Significant at the 0.10 alpha level.

Republic of South Africa

	Production	Consumption	Corruption
Production	1.000	-	-
Consumption	**0.990	1.000	-
Corruption	0.169	0.234	1.000

Note: Asterisk (**) and Red: Significant at the 0.05 alpha level.
Asterisk (*) and Red: Significant at the 0.10 alpha level.

Kingdom of Swaziland

	Production	Consumption	Corruption
Production	1.000	-	-
Consumption	0.706	1.000	-
Corruption	0.090	0.195	1.000

Note: Asterisk (**) and Red: Significant at the 0.05 alpha level.
Asterisk (*) and Red: Significant at the 0.10 alpha level.

Republic of Zimbabwe

	Production	Consumption	Corruption
Production	1.000	-	-
Consumption	0.627	1.000	-
Corruption	*-0.788	-0.403	1.000

Note: Asterisk (**) and Red: Significant at the 0.05 alpha level.
Asterisk (*) and Red: Significant at the 0.10 alpha level.

5. Conclusion

This study sought to determine the relationships between energy production, energy consumption, and corruption in six Sub-Sahara Africa countries. From this analysis, one could perhaps argue that corruption does, in fact, adversely affect the energy sector in some countries, though no effort is made herein to imply causation. For example, in Zimbabwe, a country historically riddled with political struggles, corruption decreased as energy production and consumption increased. The same held true in Mozambique; as energy production and consumption increased, corruption decreased. In Botswana, the relationship between consumption and corruption was also inversely proportional, though the relationship between production and corruption was positive and moderately strong. No significant relationship was found between energy production and consumption in Botswana or Swaziland, i.e. energy supply and demand; or in the economies of Lesotho and Swaziland. (Lesotho and Swaziland are land-locked countries, with both countries' economies being heavily tied to South Africa). In addition, no significant relationships were found between energy production and corruption or consumption and corruption in Swaziland. Accordingly, additional research should to be conducted in the energy sector of this region before definitive conclusions can be drawn. However, while political corruption may be inherit in every country, adequate infrastructure is not. The lack of adequate electricity, regardless how problematic, must be overcome in Africa, and especially Sub-Sahara Africa, if these regions are to be fully developed through private investment streams. This study will better enable and align the U.S contractors who implement infrastructure projects in these countries develop effective and efficient management strategies that match the unique characteristics governing operations of such energy sectors.

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