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Examining the correlation between energy consumption and economic growth in selected SADC countries

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ABSTRACT

Access to reliable energy that is especially modern and affordable, is a prerequisite for economic growth and improved quality of life. Accordingly, energy is an essential input for economic activity and human well-being. Estimates for technological advances in energy systems show that less than 30 percent of the population in sub Saharan Africa has access to affordable, reliable and modern forms of energy compared to 65 percent in South Asia and at least 90 percent in East Asia. Additionally, only 24.7 percent of the households in the southern most region of sub Saharan Africa have access to electricity, with biomass remaining the primary energy source. Focusing primarily on the Southern African region, this study used the time series analysis to investigate the causal relationship between energy consumption and economic growth in selected countries between 1980 and 2016. Regression analysis was used to establish the nature of the relationship between the variables. Lastly, the study predicted a 5-year energy consumption and economic growth using forecast models in Microsoft Excel. Variables were tested for statistical significance using granger causality tests. Results showed that there was a causality relationship between the two variables for Botswana and Zimbabwe. South Africa did not show any significance for analysis following the Granger causality test. Zimbabwe showed a very weak and negative linear relationship between energy consumption and economic growth. Overall, the results revealed that, in the short run, there was a bidirectional causality relationship between GDP per capita and electric power consumption per capita, and in the long run a unidirectional relationship running from GDP per capita to electric power consumption per capita. The overall findings of the study show that there is a corresponding relationship between energy consumption and economic growth. Therefore, improvements in energy generation are important for the economic development of SADC countries. Future studies may need to employ cointegration analyses to identify the degree to which variables are sensitive to the same average price over a specific period of time.

CHAPTER ONE

1.0 INTRODUCTION

The study of energy and economic growth has become a growing concern in both developed and developing countries due to its impact on sustainable development. As such, energy has been put on global agenda for sustainable development (Davidson and Mwakasonda 2004). In particular, Sustainable Development Goal number 7 provides for universal access to modern energy services by 2030. Moreover, the goal seeks to substantially increase the share of renewable energy in the global energy mix while doubling the global rate of energy efficiency.

It is largely understood that energy is a key driver to economic growth (Gamula, Hui et al. 2013). There is significant evidence that shows the need for energy to power infrastructure and production so as to generate revenue (Brown, Burnside et al. 2011). Scholars have shown that energy consumption is the actual energy demand made on existing electricity supply. Different countries have different energy profiles which are influenced by their developed and developing states. Globally, electricity consumption increases at a faster pace than other energy vectors due to electrification of energy uses in most industries. Studies show that most of the 2017 increase in global electricity consumption occurred in Asia. The electricity consumption growth in China contributed to more than half of the world electricity consumption rebound in the year 2016. Power demand also grew in Japan for the first time since 2013, in India, Indonesia and South Korea. Comparatively, electricity consumption declined for the second year in a row in 2017 in the United States due to energy efficiency improvements whereas it rose in Canada. The European Union showed an increase in Italy, Poland, Germany and Spain, Turkey and a decline in the UK. Electricity consumption also increased significantly in Iran and in Egypt.

Although Southern Africa is endowed with resources, less than 30 percent of the population in sub Saharan Africa is reported to have access to affordable, reliable, modern forms of energy compared to 65 percent in South Asia and 90 percent in East Asia (Eberhard, Rosnes et al. 2011). Other studies show that in the SADC region, 24.7 percent of households have access to electricity, with biomass remaining the primary energy source (Merven, Hughes et al. 2010). Recent studies revealed that the Southern Africa has a low access to electricity rate of 24 percent compared to 36 percent in East Africa and 44 percent for the

West Africa. Despite having inadequate electricity transmission and distribution networks, SADC is said to have abundant energy potential which however remains untapped.

More studies have investigated the relationship between energy consumption and economic growth in most developed countries. These studies showed that while energy use increases with income at household level and at per capita level of income, increased earnings result in an upward trend of modern energy use (Gamula, Hui et al. 2013). Other scholars also revealed that there is a direct positive relationship between Gross Domestic Product (GDP), energy consumption and earnings per capita. Evidently, a corresponding increase in GDP and modern energy consumption per capita is observed as energy consumption increases with economic prosperity. Studies show that commercial energy use follows a similar pattern, in scenarios where energy use is considered negligible at low levels of economic development. Other scholars showed that economic development is characterised with a strong association between industrial production commercial energy consumption. Thus, energy is understood to be a key driver for economic growth. Scholarly observations have shown a direct correlation between modern energy service provision and other development outcomes such as poverty reduction, high life expectancy, improved literacy as well as environmental sustenance. The above is why it is crucial to understand the correlation between energy consumption and economic growth.

1.1 Problem Statement

The study of energy consumption and economic growth has become a growing concern in both developed and developing countries due to its impact on sustainable development. While several studies have been done to understand this correlation, many have focused on developed economies, leaving developing economies under researched (Muse, 2014). A compelling body of literature suggests however that, the demographic increase in SADC corresponds with the demand for energy provision in the region. Yet, the demand for energy is being met with little capacity by SADC states to reliably generate and transmit energy.

Accordingly, this study uses the granger causality testing, modelling through forecasts and time series analyses in selected SADC countries to try and understand further the relationship between economic growth and energy consumption. By adding to this gap in knowledge, the study hopes to facilitate near accurate predictions for resource allocation and prioritization which will inspire funders to invest more in energy infrastructure.

1.2 Justification of study

The study contributed to development finance through informing policy and decision makers to embrace time series analyses and modelling of energy consumption and economic growth. Correlational analyses between energy consumption and economic growth are not new. However, a number these analyses have been conducted in most developed countries which cannot reflect a true picture of developing countries nor conceptualised in scarce resource settings as SADC. Time series analyses and modelling of energy consumption and economic growth is less expensive and not time consuming. Additionally, different countries are understood contextually because of their settings and comparative analyses provides a more meaningful understanding of the SADC region. Thus, the application of time series analysis and associated forecast models for energy consumption and economic growth intended to establish timeous energy efficiency and economic growth measures and sound planning. Additionally, this aimed at reducing the underdevelopment, little capacity and related energy consumption and economic growth impacts. As a result, an improved funding mechanism for energy infrastructure development is expected.

1.3 Research Questions

The study intends to answer the following research questions:

Primary Research Question,

1. Is there a correlation between energy consumption and GDP in the selected SADC countries?

Secondary Research Questions,

2. What is the trend pattern of energy consumption and GDP in the selected SADC countries between 1981 and 2014?
3. What is the trend pattern of energy consumption and GDP in the selected SADC countries over the next 5 years?

1.4 Research Objectives

The study intends to achieve the following objectives:

Primary Objective,

1. To establish a correlation between energy consumption and GDP in the selected SADC countries.

Secondary Objectives,

2. To observe trend pattern of energy consumption and GDP in the selected SADC countries between 1981 and 2014.
3. To model trend pattern of energy consumption and GDP in the selected SADC countries over the next 5 years.

1.5 Outline of the study

This study is organised into five chapters. Chapter One presents the introduction to the study, elaborating on the problem statement, justification of study, research questions and objectives. Chapter Two presents the literature on energy consumption and economic growth, the energy overview of SADC countries, economic overview of SADC countries, which includes comprehensive data about, Development Finance Institutions (DFIs) and Public Private Partnerships (PPPs). Chapter Three covers the methodology to the study. Chapter Four provides research findings, analysis and discussion of findings. Chapter Five concludes the study with a summary and conclusions of the study, policy recommendations and recommendations for future studies.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

The following sections review literature on the relationship between energy use and economic growth in SADC. To give insight into this correlation, the chapter will explore SADC's current energy situation and financial investment climate. A theoretical framework will also be tendered which encompasses economic theories and statistical methods that will be employed by the study to examine the relationship between the two variables of interest, energy consumption and GDP.

2.2 Energy consumption and Economic growth

GDP is an economic variable used to analyse economic growth (Constantini & Paglialunga, 2014). It is usually studied as an absolute value or per capita, although a production index is applied in other cases (ibid). As highlighted in Chapter 1, energy is an essential input for economic growth. Therefore, it is crucial to understand the relationship between energy usage and economic growth (Jakovac, 2004). The correlation between the two variables became a common research subject after the oil crises of the 1970s, where OPEC members agreed to stop exporting oil to the United States (US) (Esen & Bayrak, 2017a). The oil embargo by OPEC members came at a vulnerable period for the US economy and worsened the recession. Prior to the oil crisis however, the role played by energy as an important input of production had been overlooked. As such, the oil crisis highlighted the critical importance of energy as a crucial input for achieving economic growth (ibid).

Since the 1970s, a number of empirical studies have been carried out to examine the causal relationship between economic growth and energy consumption, yet, the causality direction remains largely contested grounds. Kraft and Kraft were the first scholars to investigate the correlation between energy consumption and economic growth. In their 1978 study, their primary goal was to analyse the direction of causality between energy consumption and economic growth at national level (see Kraft and Kraft 1978). Using annual data from the US between 1947 and 1974, their study discovered a unidirectional causal relationship going from economic growth to energy consumption. As such, they concluded that economic growth leads to increased energy consumption. Yang (2000) investigated the causality relationship between energy consumption and gross domestic product in Taiwan and discovered that GDP has a bidirectional causality relationship with total energy consumption, coal consumption and electricity consumption, and a unidirectional causality relationship with natural gas consumption and oil consumption. Whereas, Wolde-Rufael (2004) examined the relationship between energy consumption and GDP in his study on Shanghai and discovered a unidirectional causality relationship between coal, electricity and total energy consumption and GDP. No causality relationship was detected between oil consumption and GDP. His study concluded that long-term and short-term energy consumption is a unidirectional causality of GDP and that a high level of energy consumption led to an increase in the GDP level.

Although, many studies have investigated the causal relationships between energy consumption and economic growth in countries across the globe, fewer have been conducted on the causal relationship for SADC countries. Energy studies in Africa have focused more on Middle East and North African (MENA) countries. An example of such studies is that of Al-Mulali (2011) who conducted a panel data model examining the effects of oil consumption on economic growth in MENA countries, for the period 1980-2009. Using results from a cointegration test, he found that carbon dioxide emissions and oil consumption have a long-term relationship with economic growth. His study also found a bidirectional causal relationship between the three variables in both the short and long-term. Al-Mulali’s (2011) study showed that oil consumption played a significant role in the economic development of MENA countries. Omri (2013) is another scholar who conducted a study on the relationship between energy-environment-GDP nexus for 14 MENA countries. His study also found a bi-directional causal relationship between energy consumption and economic growth. Al-Mulali and Sab (2012) further carried out a study, using a panel data model on the effects of energy consumption and carbon dioxide emission on the economic growth of Sub-Saharan African countries, for the period 1980-2008. Results showed the important role that energy consumption had in increasing economic development and financial development in investigated countries.

According to Costantini and Paglialunga (2014), studying the role of energy in relation to the direction of the causal relationship presents different possibilities which are expressed in four hypotheses. These are:

i. The neutrality hypothesis which holds true if there is no causal relationship between energy consumption and economic output, suggesting that energy has no major influence on economic growth.
ii. The feedback hypothesis which holds true for bi-directional causality, suggesting that energy consumption and economic output are independent variables that affect each other.
iii. The conservation hypothesis which holds true in the case of uni-directional causality, suggesting that the level of economic activity causes energy consumption.
iv. The growth hypothesis which holds true if there is causal relationship running from energy consumption to economic output, suggesting that energy is an important input in all stages of production and can indeed impact on economic growth.

In light of the diverse scenarios presented above, studies not only apply different econometric methods but take into account different periods of time and countries which tends to yield diverging results (Costantini & Paglialunga, 2014). This is true seeing that countries often have diverse structural and development characteristics, as observed also concerning SADC countries (see Chapter 1). As a result, some empirical studies find that energy consumption contributes to economic growth, while other findings show that energy consumption has no effect on economic growth or that its effect is negligible (Esen & Bayrak, 2017b).

2.3 Factors Affecting the Linkage between Energy and Growth

Studies have established numerous factors affecting the linkage between energy consumption and economic growth. Stern and Cleveland (2004) cite four factors which can affect the relationship between energy and an aggregate of output such as GDP, and these are; (1) substitution between energy and other inputs (2) technological change, (3) shifts in the composition of the energy input, and (4) shifts in the composition of output. This section will touch on all four factors.

2.3.1 Energy and Capital: Substitution and Complementarity

A study by Apostolakis (1990) noted a substitution relationship between energy and capital in the long-term and a complimentary relationship in the short-term. To explain the concept of substitution, Thompson and Taylor (1995), explain that capital and energy are seen to be substitutes when the Morishima elasticity of substitution (MES) is applied. "The Morishima elasticity of substitution measures the percentage change in the optimal (input) quantity ratio induced by a percentage change in relative (input) prices" (Sharma, Kandil, & Parker, 2006). MES is generally estimated at an industrial level and not economic level which is more relevant to economic growth (Stern & Cleveland, 2004). More importantly however, it has been observed that capital and energy are at best, weak substitutes, and are possibly complements (ibid). On the question of complimentary, energy and capital are said to be complements when the cost share of energy is small (Frondel & Schmidt, 2002). The level of complementarity will differ however across industries and considering the level of aggregation.

2.3.2 Energy efficiency and technological change

Energy efficiency explains the attaining the most value potential from the least amount of energy used in production or consumption. Scholars agree that energy efficiency involves utilising energy with minimal loss and optimum efficiency through long processes such as production and distribution. Therefore, an energy source that is obtained rapidly and at minimum cost with low investment cost is efficient. On the other hand, energy intensity, which is the quantity of energy consumed per GDP, is one of the key indicators of energy efficiency. The ideal situation for development is when high energy consumption per capita and low energy intensity are achieved. Technological changes are closely linked to energy efficiency, as technological improvements increase energy consumption per output.

2.3.3 Energy quality and economic growth: Shifts in composition of input

Energy quality is the relative economic usefulness per heat equivalent unit of different fuels and electricity (Stern & Cleveland, 2004). Energy quality is measured by the marginal product of fuel, which is the marginal increase in the quantity of goods or services produced using one additional heat unit of fuel. Accordingly, the highest quality of energy is from electricity, followed by natural gas, oil, coal and wood (Stern & Cleveland, 2004). Schurr and Netschert (1960) stress on the importance of energy quality on the economy. They argue that the amount of energy needed to produce a dollar of GDP reduces with a shift to higher quality fuels. Kaufmann (2004) finds that in the US, shifting from coal to oil over the period 1929-1999 improved energy quality while reducing energy intensity. Overall, development should be centred on the ability to produce more economic output with a lesser amount of energy, and this speaks to energy quality (Esen & Bayrak, 2017a).

2.3.4 Shifts in composition of output

According to Stern and Cleveland (2004), the energy output mix changes over the course of economic development. In the early stages of economic development, there is a shift from agriculture to heavy industry, whereas in the later stages, there is a shift from heavy industry to lighter manufacturing. Panayatou (1993) concurs with this view, submitting that more energy per unit of output is used in the initial phases of economic development, reducing in the later stages of development. Be that as it may, it is also argued that service industries remain energy intensive at all stages of development as the infrastructure required such as transport, office buildings, warehouses and shopping malls consume a lot of energy. Therefore, it is unlikely that total decoupling of energy consumption and economic growth is an outcome of changing from heavy industry to the service sector. As Stern and Cleveland (2004) rationalise further, there is minute evidence to suggest that the change in output mix that has happened in developed countries over the past few decades has considerably reduced the energy/GDP ratio. Rather, is believed that developed countries such as the United States have experienced a decoupling of energy consumption and increase in GDP (Esen & Bayrak, 2017a). For example, energy consumption between 1973 to 1991 did not change in United States, where GDP increased significantly. In total, it is commonly believed that in the long term, the impact of energy consumption to economic growth becomes invariable. This is especially true for developed countries (ibid). While Esen and Bayrak (2017a) tend to agree that shifts in the composition of energy input have a bearing on GDP output, they submit a crucial viewpoint which is that, countries that depend more on energy imports experience disruptions in the macroeconomic equilibrium, exposing the economy to external shocks. To date, empirical studies have provided little information on whether the importance of energy consumption to economic growth varies subject to dependence on imports or the level of income of a country (Esen & Bayrak, 2017b).

2.4 Theoretical Framework: Neoclassical vs Ecological Model

There are two approaches which are commonly used to explain economic growth and energy consumption. These are known as the Neoclassical and Ecological models. The neoclassical approach evaluates the economic structure as a closed system. This approach views energy as a primary factor of production, and is mainly influenced by developed intrinsic growth models, including, public spending (Barro, 1988) and human capital (Lucas, 1988) On the contrary, the ecological perspective argues that the closed system employed in the neoclassical approach isn't realistic since the economic system is an open global system.

Neoclassical growth models usually regard capital, labour and land as the primary factors of production, while energy is regarded as an intermediate input eventually produced by the primary factors of production. Furthermore, neoclassical economists often assume that energy and capital are perfectly substitutable (Solow, 1974). Thus, a decline in energy use does not, under conditions of economic efficiency, result in a reduction in economic growth. These viewpoints have led to a focus in the mainstream growth theory on the primary inputs, and in particular, capital and labour, more so given that land is usually subsumed as a subcategory of capital. As such, energy is assumed to have a relatively minor role in economic production in the mainstream theory of growth. As will be demonstrated in Chapter 4, this study is more favourable to the Neoclassical model, as the findings support that energy is a primary factor of production which has a direct correlation with public spending and ultimately, economic growth.

2.5 Energy consumption in Sub-Saharan Africa (SSA)

Energy in Sub-Saharan Africa is dominated by animal waste, biomass, industrial and municipal waste which are non-commercial, combustible sources (Kebede, Kagochi, & Jolly, 2010). Biomass accounts for 30 percent of energy consumed in SSA and is predominantly used in households for cooking, heating and lighting (Kebede et al., 2010). According to the International Energy Agency (IEA) (2002), only 23 percent of SSA has electricity access with big differences between countries, and across geographic (e.g. rural and urban populations) and demographic (e.g. rich vs poor) lines in these countries. Rural areas in SSA have lesser electricity coverage than urban areas, whereas, in urban areas, poor communities have lesser access to reliable electricity than rich communities (Banda, 2014).

The supply of modern energy has been hampered by inadequate investment and development of energy infrastructure in SSA (IEA, 2002). As a result, energy supply in SSA countries is inefficient, at a high cost and poor quality which limits the consumption by majority of the population. In fact, Kedebe et al (2010), suggest that the gap between energy supply and consumption in SSA has increased over the past 40 years and is expected to continue growing. Therefore, most countries in SSA have not yet fully realised the various social benefits of modern energy supply which include improvements to health, income generation opportunities, employment, education and social services (ibid).

The table below shows the main source of energy consumption in SSA.

Figure 1: Sources of energy use in Sub-Saharan Africa

Year	Petroleum[a]	Electricity[a]	Woodfuel[b]
1980	0.23	0.06	0.71
1985	0.23	0.04	0.73
1990	0.24	0.05	0.71
1995	0.19	0.04	0.77
2000	0.22	0.04	0.74
2005	0.23	0.05	0.72

Source: Kebede, Kagochi and Jolly (2010)

To boost economic growth and energy consumption, SSA countries need to shift from a heavy reliance on traditional energy and invest more in modern and renewable energy sources which are affordable, efficient and reliable.

2.6 Energy Overview in SADC

The Southern African Development Community (SADC) is an amalgamation of 15 African states that are geographically located in southern Africa. The inter-governmental organisation was founded in 1980, ratified by 9 autonomous member states (namely Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe) in what became known as the Lusaka Declaration. Then called the Southern African Development Co-ordination Conference (SADCC), the mandate of the organisation was 'economic liberation' and later, 'economic integration' in 1992 when self-rule had become a possibility for all SADC states (Vanheukelom & Bertelsmann-Scott, 2016). The realignment of mandates entailed a name change of the organisation to the current Southern African Development Community (SADC). The additional member states were the Democratic Republic of Congo (DRC), Madagascar, Mauritius, Namibia, South Africa, Seychelles, and Swaziland. The major shift was sealed by a SADC Treaty, Article 5 which stresses inter alia, the goal of achieving economic growth through regional integration as built on democratic values and reasonable sustainable development (Southern African Development Community (SADC), 2012). It is in 2001 however, that a comprehensive development and implementation framework of SADC - the Regional Indicative Strategic Development Plan (RISDP) was formulated, which went on to give rise to more regional integration agendas such as the Regional Infrastructure Development Master Plan (RIDMP) of 2012 (SADC, 2012).

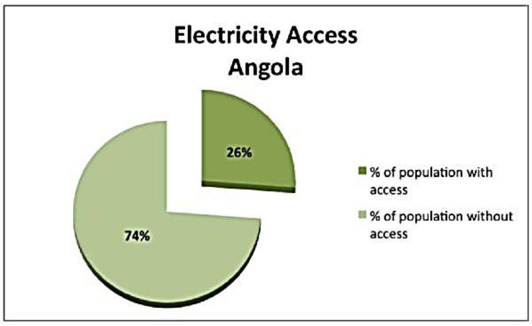
In line with SADC's mandate of economic integration, the RISDP focuses on encouraging and supporting regional economic development, trade and investment thus eradicating poverty and improving social conditions. With the RISDP being the touchstone document used by the SADC Secretariat to inform the identification of priorities and work plans for regional officials (Vanheukelom & Bertelsmann-Scott, 2016), the RIDMP serves accordingly as the infrastructure development blueprint for the region. The implementation of the RIDMP is set over three phases, that is, the short term from 2012–17; medium term 2017–22; and the long term from 2022–27. Focus is on six development sectors which are energy, water, transport, tourism, meteorology and telecommunications (Dube, 2013). Of the six target sectors, the energy sector bears more relevance to the discussion in this study. The overall goal of SADC's energy sector is to ensure the availability of sufficient, reliable and affordable energy services which will assist in the attainment of economic efficiency and the eradication of poverty whilst ensuring the environmentally sustainable use of energy resources (SADC, 2001). In keeping with this goal, the SADC Protocol on energy was signed in August 1996, coming into full effect in April 1997. It is this Protocol that initiated the ideals of regional cooperation in the development of energy, strengthening the efforts of power pooling that had begun in 1995 (Vanheukelom & Bertelsmann-Scott, 2016). The Southern African Power Pool (SAPP) designed to work through a regional market for surplus electricity, was Africa's first regional power pool (Vanheukelom & Bertelsmann-Scott, 2016). In terms of its progress however, it is believed that energy trade among countries within the SADC region remains fairly limited, with most member states depending on energy exports from South Africa which is the dominant provider regionally (Eberhard et al., 2011). Compared to other regional pools in Africa, the SAPP now lags behind power pools in East and West Africa (Southern African Development Community (SADC), 2012). The preceding scholars suggest that the fragmented nature of the region seen through vast differences in socio-economic, infrastructural conditions and peculiar national legislative frameworks in part accounts for delays in the successful integration of regional energy systems in the SADC region.

Altogether, the SADC region is facing a serious deficiency of power with the situation anticipated to continue as the regional energy generation capacity is falling behind the expected timeline. Like most countries in SSA, biomass is the major source of energy for countries in SADC. Even so, biomass use varies per country. For instance, 70% of the energy used in the Democratic Republic of Congo (DRC) comes from biomass (SADC, 2016), whereas countries such as Mozambique, Tanzania and Zambia consume 60% biomass energy

(REN21, 2015). The high consumption levels of biomass in SADC can also be attributed to the fact that much of the population is rural and has limited access to electricity. According to the SADC secretariat (2015) in 2013, of the 294 million people in SADC, only 39 percent made up the urban population. Again, like most countries in SSA, SADC needs to shift from a heavy reliance on traditional energy and invest more in modern and renewable energy sources which are affordable, efficient and reliable. The following sections will give country specific energy profiles for SADC countries.

2.7 SADC Country Specific Energy Picture

Angola



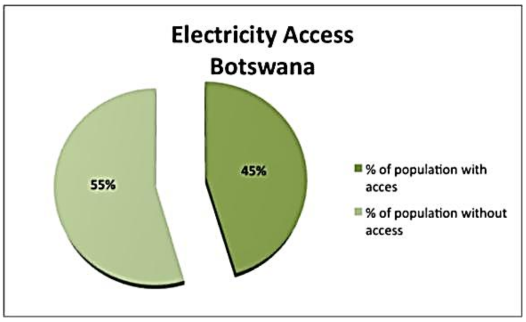
Source: Waagsaether (2014)

Angola is one of the biggest producers of energy in the SADC region due to its massive hydropower and oil industry (UNEP, 2016). However, electricity access is limited to 26 percent of the 18 million people who make up the total population of the country, with 83 percent of the urban population having access to electricity (Waagsaether, 2014). According the US Energy Information Administration (EIA) (2016), the electricity infrastructure of the country was significantly damaged during the 27 year civil war between 1975 – 2002 (US Energy Information Administration, 2016). Notwithstanding the disproportionate access to energy in Angola, the country, through financial assistance from the Chinese, has experienced a doubling in installed capability of electricity from 462 thousand kilowatts to 1155 thousand kilowatts between the period 1990 – 2008 (Waagsaether, 2014). Hydropower and renewable energy make up over half of electricity generation with the remainder coming from thermal power. Only 0.2 percent of the population uses electricity for cooking while the rest still rely on gas, firewood and charcoal especially in the rural areas where only 6 percent have access to electricity (UNEP, 2016).

The EIA (2016) report states that the Angolan government planned to invest US$23 billion in the electricity sector by 2017, to improve the country's transmission and distribution network.

With the help of foreign investment, the government plans to build 15 hydropower plants which will increase hydropower capacity to 9000 MW by 2025 (ibid). This will double the country's electrification rate to 60 percent (ibid).

Botswana

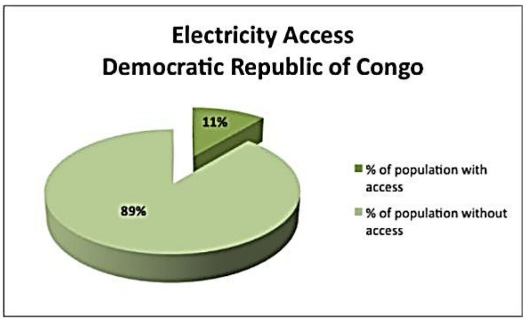


Source: Waagsaether (2014)

Botswana is one of the smallest countries in the SADC region by population size, with a population of only 2.02 million (UNEP, 2017). Botswana has an energy deficit which requires that more than 80 percent of its energy be imported from South Africa and Zambia (ibid). The remaining 20 percent of Botswana's electricity is produced internally from thermal sources such as coal, due to its abundance and cost effectiveness, with solar energy contributing only 0.1 percent. The country has potential for electricity generation from other sources such as solar, wind and biomass. Botswana has one of the highest levels of solar insolation in the world (ibid). Research has estimated that Botswana could meet its current energy consumption, using only one percent of the countries area for solar energy (ibid).

According to Waagsaether (2014), Botswana's Rural Electrification Collective Scheme (RECS), has been significant in increasing electricity access. The RECS has resulted in electricity access by rural homes increasing by five times in the seven-year period from 1996 to 2003. Despite the significant progress in rural access to electricity, less than 50 percent of the total population have access to electricity (ibid). Gas and wood remain the most commonly used energy source for cooking by households, with only 7 percent of the population utilising electricity for cooking. Botswana aims to increase electricity access to 100% by 2030. According to Essah and Ofetotse (2014) to achieve this goal, the country has the following objectives: 1) Increasing access to affordable electricity to all sectors of the economy and the general population, specifically the poor; and 2) Improving the diversity in electricity supply by investing in local supply sources such as coal and solar instead of relying mostly on imports.

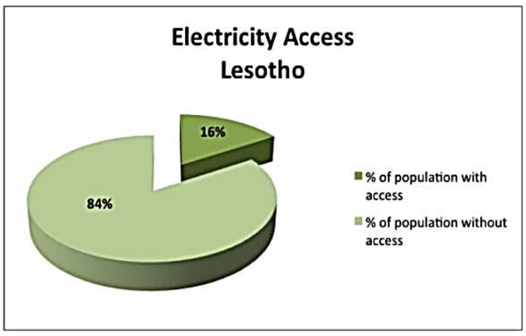
Democratic Republic of Congo



Source: Waagsaether (2014)

Hydro-electricity accounts for 98.7 percent of the electricity generation in the Democratic Republic of Congo (DRC). The country has a huge hydroelectric potential due to its rich hydrographical location. Only 1.3 percent of electricity generation in this country is from non-renewable sources. The DRC has a potential hydropower generation capacity of about 100 000 MW, of which 44 percent would be from the Inga Dam (Kusakana, 2016). The Inga Dam has potential to hold the biggest hydropower stations in the world if its capacity is fully exploited. If this is done, the DRC would be able to electrify the whole country and export surplus to other African countries (Lukamba-Muhiya & Uken, 2006). It is estimated that if the hydropower potential is developed, the country will be able to generate revenues of over 6 percent of GDP (UNEP, 2015a). Currently the country's production capacity is at 47 percent due to the poor state of its hydroelectric power stations, with the Inga I and Inga II power stations being in dire need of repairs and substantial rehabilitation (Kusakana, 2016). The DRC has the largest population in SADC, with 75 million people yet only 11 percent of the population has access to electricity (Waagsaether, 2014). Of the 11 percent, only 50 percent use electricity for cooking. Unlike most SADC countries, access to electricity in the rural areas is significantly more than in the urban areas (Waagsaether, 2014). The primary energy source remains to be from biofuels such as biomass energy, charcoal and firewood.

Lesotho

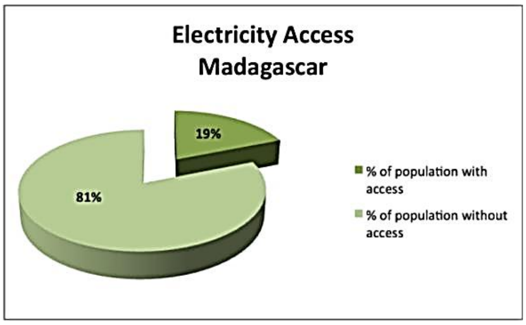


Source: Waagsaether (2014)

99 percent of electricity generation, which only contributes 4 percent of the country's energy balance, in Lesotho is from hydropower. The combined generation from the four small hydropower stations owned by the Lesotho Electricity Company is 3.25 MW, while the Muela hydropower plant has a maximum generating capacity of 72 MW. It is estimated that by 2020 peak demand is expected to increase to 304MW and 432 MW by 2030 (Department of Energy, 2017). The country must import electricity from Mozambique and South Africa when national demand exceeds 72 percent. Lesotho has one of the lowest electrification rates in in Africa, with only 20.6 percent of the 2 million population having access to electricity. Most of the access to electricity is concentrated in the urban areas, with 47 percent of the urban population having access compared to 10 percent in the rural areas (UNEP, 2015b).

In addition to hydropower, Lesotho has potential for electricity generation from renewables such as solar and wind. Renewable energy is set to play a significant role in rural electrification within the country. The government is targeting that by 2020, 35 percent of the rural electrification will come from renewable energy sources (Waagsaether, 2014). Most households use a combination of energy sources. For instance, traditional sources (e.g. dung, agricultural residues and fuel wood), intermediate sources (e.g. coal and kerosene) and modern sources (e.g. liquefied petroleum gas (LPG) and electricity) (UNEP, 2015b).

Madagascar

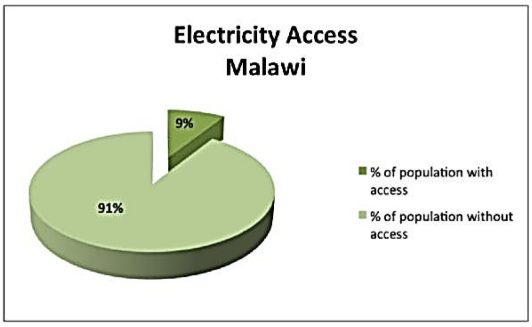


Source: Waagsaether (2014)

Madagascar is an island nation whose population in 2013 was estimated at 22.92 million (UNEP, 2015c). Total electricity production of the country was 223 thousand tonnes oil equivalent (ktoe) of which 62 percent was from thermal sources and 36 percent from hydropower (ibid). Madagascar has the potential to produce 7800 megawatts (MW) of electricity from hydropower, however only 2 percent of that potential is being realised at present. Madagascar has an installed generating capacity of 356MW from hydropower and 150MW from thermal power to serve a population of 24 million (USAID, 2016). The country has potential for the production of renewable energy from geothermal, hydropower, ocean energy, solar and wind which are of importance to the country as it aims to grow renewable energy production to 74 percent of total energy production (Waagsaether, 2014).

While Madagascar's installed capability for electricity has increased two-fold since 1990, according to 2015 data, electrification rate reached only 15 percent (USAID, 2016). Madagascar's power sector is faced by significant challenges which include low distribution and transmission capacity. The country has one of the lowest rates of annual consumption of electricity per capita, in Africa. Electricity consumption is estimated at 48.53 kWh, which is only a third of the normal consumption for SSA countries (ibid).

Malawi



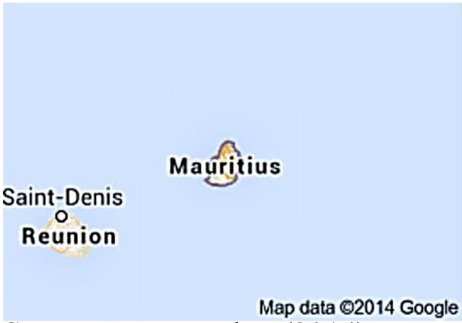
Source: Waagsaether (2014)

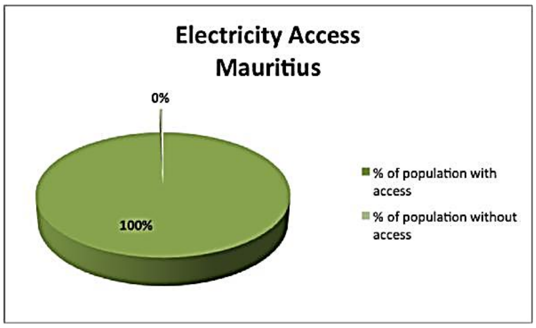
Malawi is a land locked country with 20 percent of the country being covered by water, therefore it would not be unusual that 99 percent of electricity production in Malawi is generated from hydropower (Waagsaether, 2014). The country has great potential to expand its hydropower generation, including other renewable energy sources such as biogas, geothermal, solar and wind. The sugar industry in Malawi has an important role as it provides prospects for biogas as well as biomass (ibid).

While the country has experienced a tripling in its installed capacity of electricity since 1990, there is need to increase generation capacity further. Of Malawi's 14.4 million inhabitants, only 9 percent of the urban population has access to electricity access (Waagsaether, 2014). Due to deficiencies in energy supply, only 1 percent of the rural population Malawi has access to electricity due to deficiencies in energy supply (ibid). Wood and charcoal account for 88.5 percent of the country's energy requirements with only 6.4 percent coming from petroleum and 2.8 percent from electricity. About 83 percent of energy is consumed by households, making them the biggest consumer. Industry consumes only 12 percent of the energy, the transport sector, 4 percent and the service sector, 1 percent (Gamula et al., 2014). Only 2 percent of the population use electricity for cooking. 88 percent of use firewood, 8 percent use charcoal, 1 percent uses paraffin and another 1 percent uses means such as crop residues and animal dung (ibid).

One of the major challenges facing the energy sector in Malawi is the budget allocation towards energy which has been a fraction of the national budget. The financial investment towards energy has not been in line with the global energy trends which has to change if the government is to make progress in achieving its agenda of improving energy supply (Gamula et al., 2014).

Mauritius

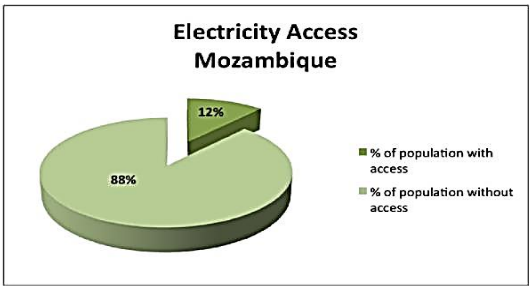




Source: Waagsaether (2014)

Mauritius is the only SADC country that has managed to achieve total electrification of the country. This has been achieved by ensuring sufficient production and roll out of the national grid (Waagsaether, 2014). The country has managed to achieve this due to huge private sector investment in the electricity sector, which contributes 40 percent of electricity generated (Hassen & Bhurtun, 2015). The Central Electricity Board (CEB) generates most of the country's electricity requirement with the remainder being bought from Independent Power Producers (IPPs), three which produce all year round and seven that produce during sugar cane crop season (ibid). Although the country's electricity is accessed by relatively few people, low income earners have also been able to access electricity due to low tariffs. Electricity is priced in line with consumption per household. Much of the electricity generated in Mauritius comes from thermal sources which include bagasse, coal and fuel oil (ibid). Only 37 percent of the total power generated is from renewable energy. The country has the potential of expanding capacity of renewable energy from sources such as biomass, hydropower, solar and wind (Waagsaether, 2014). The country used to rely on biofuels such as wood, kerosene and charcoal for household energy sources, however, the state has enabled a change towards the consumption of LPG gas. The outcome is that 98.3% of the total population of 1.3 million now cook using gas (Waagsaether, 2014). Although Mauritius is unique in that it has a smaller population and higher GDP per capita compared to other SADC countries, member states can learn from the country's experiences and approach to energy.

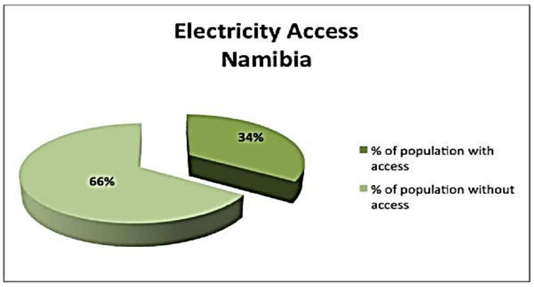
Mozambique



Source: Waagsaether (2014)

Mozambique is the second biggest producer of electricity in SADC. This is due to the country's hydropower capacity. Hydropower makes up 98 percent of the electricity generated, with only two percent generated from biomass, diesel, thermal, solar and wind (Waagsaether, 2014). The country has promising renewable energy projects, such as the Mphanda Nkuwa hydropower project (1,500 MW) and the extension to the North Bank of the Cahora Bassa (additional 1,245 MW) which could produce cheaper electricity for the whole region (The World Bank, 2015). However, the transmission line would require extensive refurbishment to enable the exportation of more electricity (ibid). Despite the high production of electricity in Mozambique, consumption is dominated by electricity-intensive industries and electricity exports such that only 25.2 percent of the households had access to electricity in 2014 (The World Bank, 2015). 70 percent of the population lives in rural areas and only 1.3 percent of this population has access to electricity. Wood and coal remain the major sources of energy for cooking, similar to other SADC countries (Waagsaether, 2014).

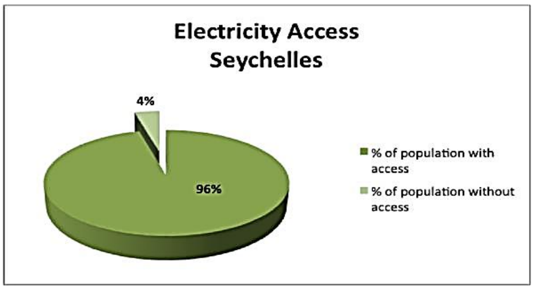
Namibia



Source: Waagsaether (2014)

Namibia's electricity supply consists mainly of imports from the DRC, Zambia and Zimbabwe, as well as from its own hydropower and thermal power stations (Waagsaether, 2014). The current reliance on imported electricity is not sustainable, as these countries are also experiencing challenges with their own electricity supply. Even so, 70 percent of the urban population and 13 percent of rural population have access to electricity (Waagsaether, 2014). Namibia developed a White Paper on Energy Policy whose focus is on energy access for households. This has led to energy shops providing subsidised loans to individuals with energy technologies and appliances which work off the grid. This is one of an initiatives that the country is implementing to expand access to electricity for rural households (Waagsaether, 2014).

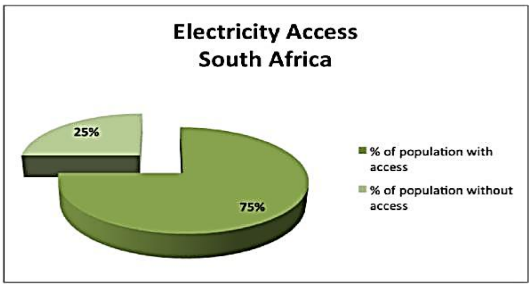
Seychelles



Source: Waagsaether (2014)

Seychelles, a group of islands located in the Indian Ocean, is the least populated country in SADC with a population of 87000 inhabitants. Seychelles has the highest GDP per capita out of all SADC countries. The country has almost achieved total electrification with 96 percent of the population having access to electricity. Currently, Seychelles does not produce energy from renewables but relies on imports of refined petroleum which is a significant cost to the economy (REEGLE, 2012). Despite its heavy reliance on oil imports, the country aims to generate 15 percent of its electricity from renewables by 2030. The country has significant potential to replace some of the power generated by oil with renewable energy such as solar energy and wind energy. An energy initiative based in Abu-Dhabi is presently exploring the potential of installing 18 MW offshore wind farm on the Mahé Island (ibid).

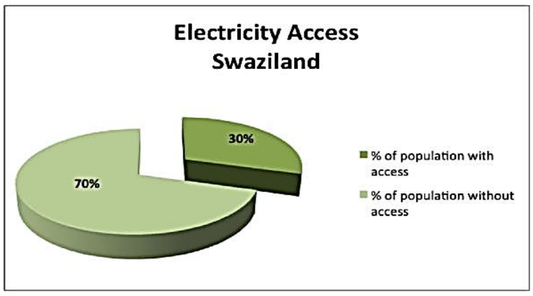
South Africa



Source: Waagsaether (2014)

South Africa is by far the major producer and exporter of energy in the SADC region. 68 percent of the country's energy supply is from coal, followed by oil and oil products which make up 17 percent. South Africa also generates energy from natural gas, nuclear and renewable energy sources (Waagsaether, 2014). The country has a set target for producing 13 percent of electricity from renewable sources by 2020. South Africa's installed capacity of electricity almost doubled from 26,392 MW to 43,061 MW between 1990 – 2008. During this period, the country was able to electrify over 5 million homes, which meant that 75 percent of the population had electricity access by 2008 (ibid). The residual 25 percent comprised largely of the rural population. To increase electricity access, the government granted private companies rights to install off-grid energy utilities in designated concession areas in the year 1999 (Waagsaether, 2014).

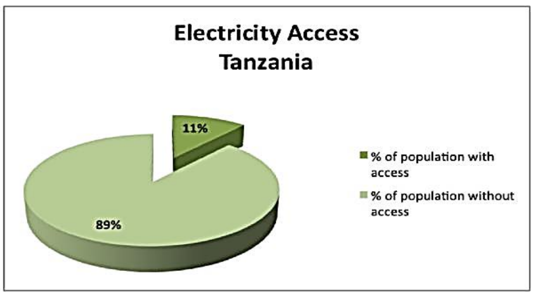
Swaziland



Source: Waagsaether (2014)

The Kingdom of Swaziland is one of the smallest electricity producers in the SADC region. 30 percent of the total population of 1 million people have access to electricity. Of this percentage, 65 percent is urban and 20 percent, rural (Waagsaether, 2014). Less than 50 percent of the population with electricity access use it for cooking, while much of the population still cook using wood (ibid). Biomass contributes to 89 percent of electricity generation in Swaziland. However, there is also potential to produce renewable energy from hydropower, solar and wind (Waagsaether, 2014).

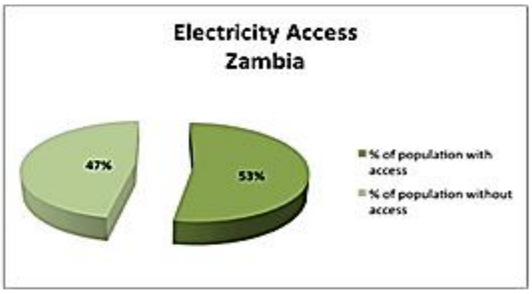
United Republic of Tanzania



Source: Waagsaether (2014)

Tanzania is the third most populous country in SADC with a populace of 44,5 million people. However, approximately 10 percent of the population has electricity access (Waagsaether, 2014). Tanzania is endowed with diverse energy sources (e.g. biomass, hydro, uranium, natural gas, coal, geothermal, solar and wind) most of which remain untapped (Matyelele, 2013). Hydropower contributes to 99 percent of the electricity generation, and thermal power, 1 percent (ibid). Due to scarce financial resources, the government has faced financial challenges expanding the distribution system and national grid. Rural electrification has been particularly problematic as evidenced by the 2 percent population rural population that has access to electricity (Waagsaether, 2014). To facilitate rural electrification, the Tanzanian government has put together a framework for the development of small power projects utilising renewable energy technologies (ibid).

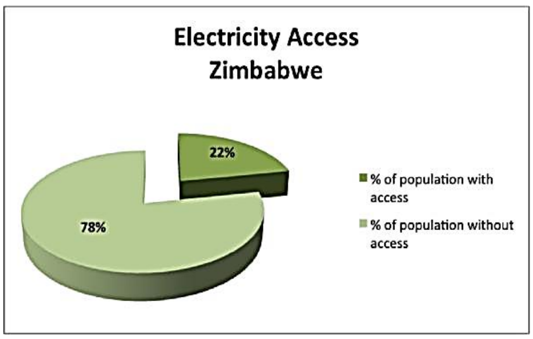
Zambia



Source: Waagsaether (2014)

Zambia has a national electrification rate of 18.8 percent. While 47 percent of the urban households have access to electricity, rural electrification remains low at 3.3 percent (Hivos, 2010). Despite having a relatively high access to electricity, over 50 percent of the Zambians use wood for cooking, while over a 33 percent use charcoal and 17 percent, electricity (Waagsaether, 2014). Hydropower contributes to 95.9 percent of the electricity generation, and thermal power, 4.1 percent (Hivos, 2010).

Zimbabwe



Source: Waagsaether (2014)

Of Zimbabwe's population of 13 million people, 22 percent have access to electricity (Waagsaether, 2014). As with many SADC countries, access to electricity is greater in urban areas as compared to the rural areas. Thus, 53 percent of the urban population has access to electricity, as opposed to 4.5 percent of the rural population. Due to economic hardships faced by Zimbabwe over the past two decades, the country has experienced fluctuations in electricity production (ibid). However, it is thought that production levels have begun to stabilise, but staggeringly mirror 1990 levels. At least 57 percent of Zimbabwe's electricity supply comes from hydropower, while 43 percent is from thermal energy (Makonese, 2016). The country has significant potential for renewable energy from geothermal sources, solar and wind, and could also benefit from the expansion of biomass and hydropower energy sources (Waagsaether, 2014). Like other SADC countries, the primary source of energy in Zimbabwe is biomass, with two thirds of the population using wood for cooking, while a sizeable portion uses electricity (ibid).

2.8 Regional Infrastructure Development Plan (RIDMP): Energy Sector Plan

The Energy Sector Plan (ESP) is part of the RIDMP, which defines regional infrastructure requirements and conditions to facilitate improvements in crucial sectors such as energy, water, transport, tourism, meteorology and telecommunications (SADC 2012). Table 1 below shows the strategic priority goals proposed for the ESP to address energy infrastructure gaps in SADC.

Table 1: Strategic priority goals proposed for the ESP

Electricity priority goals	P&G priority goals	Coal priority goals	RE priority goals
Adequate generation and transmission capacity	Joint exploration, development of trans-boundary petroleum and gas infrastructure (refineries, pipelines, storage facilities)	Adequate coal production, adequate distribution network and well-designed stock facilities	Exploited abundant renewable energy resources increasing clean energy in the generation mix and also contributing to clean energy access
Improved energy access	Joint procurement of petroleum products	Planning and application of clean coal technologies	Regional manufacturing of RE products
Harmonised cross border policy and regulatory frameworks	Harmonised policies, regulations and legislation to facilitate cross border trade and improve capacity utilisation	Coordinated planning with mining and transport sector for production and delivery of coal	Adequate grid capacity for connection of RE plants
Strong SADC institutions with a stronger mandate	Co-ordinated planning of trans-boundary oil and gas systems	Regional coal development and export strategy	Dedicated institutional framework for RE/EE
Centralised planning	Dedicated institution for petroleum and gas planning	Co-ordinating institutional arrangements	R&D and testing facilities for RE
Investment and financing Plan			

Source: SADC (2013)

A crucial aspiration of the RIDMP is to achieve regional integration, economic growth and poverty eradication in the SADC region by 2027 (SADC, 2013) (see Chapter 1). With this goal in mind, the ESP specialises in promoting regional integration through collaborative infrastructure development in the energy sector. It seeks to boost economic development by ensuring energy security and poverty alleviation through increased access to modern energy services. The ESP also seeks to promote energy investment and achieving environmental sustainability through addressing aspects of climate change (ibid).

2.9 Financial Investment in the RIDMP

The capital requirement for the inclusive RIDMP projects needed to fund the first phase of infrastructural development between 2012-17 was an estimated US$64 billion, and a further total of US$500 billion is required to complete the RIDMP's vision 2027 (Jackson, 2013). Of the latest capital requirement, at least $100 billion is expected to come from private sector financing sources (Hinds, 2015). In terms of electricity generation, the estimated costs required between 2012 and 2027 include a minimum of US$114 billion and a maximum of US$233 billion (SADC 2012). The related transmission investment costs to support new generation capacity also during this period are in the region of US$540 million (ibid). However, as highlighted in Chapter 1, the biggest challenge for infrastructure development in SADC is that of funding. This is especially true since governments are often unable to bear the full cost of energy development and rely on external funding to implement infrastructure projects. Despite lacking the capacity to bear the full cost of energy development, governments remain the conventional source of funding for infrastructure through public funding which is in the form of national budgets (SADC 2012).

Put together, the key funders for the SADC infrastructure development programme include the member states, development finance institutions (DFIs), and overseas development agencies (Dube, 2013). As Hinds (2015) states however, both public investments and overseas development assistance will not be sufficient to fill regional and national gaps, demanding enhanced private sector participation.

Reviewing the funders noted above exclusive of national budget, state owned DFIs are often accused of being subjected to political influence, while private owned DFIs are blamed for focusing more on SME funding than infrastructural development (Hinds, 2015). Overseas development funders which can be broken down into traditional (western donors) and emerging markets (eastern donors) are also not short of criticism. The former are thought to have reduced their commitment towards infrastructure projects (Hinds, 2015), whereas the latter (i.e. BRICS partners Russia, India and China) have pledged multimillion dollar loans for infrastructure development across Africa but at a cost (Jackson, 2013). As Dube (2013) notes, emerging markets selectively fund a few resource-rich countries in infrastructure development that is aimed essentially at roads, rail and power stations with the main purpose of enabling the mining and export of natural resources. Another problem with emerging market funders is that they are mostly involved in bilateral arrangements rather than regional arrangements (Dube, 2013).

Despite the negatives, the SADC RIDMP needs all the funding it can get if its vision 2027 is to be a success. To boost the current funding, SADC (2012) states the need to look to private sector contribution in the form of Build-Operate-Transfer (BOT), Build-Own-Operate (BOO), Build-Own-Operate-and-Transfer (BOOT) and Public Private Partnerships (PPPs) as reasonable alternatives for funding large infrastructure projects.

2.10 Economic Overview of SADC Countries

A 1995 report by the Department of the House of Representatives of the Australian Parliament (1995) noted that all countries in the Sub-Saharan region experienced a decline in their economic performance over 30 years prior to 1995, yet countries in SADC have generally performed better than the rest of the SSA region. Even so, SADC has some of the poorest countries on the continent (see Table 2 below). Moreover, the region's economic performance is currently below the growth target of 7 percent per annum (African Development Bank, 2018).

Challenges still faced by the region include high unemployment, fiscal leakages and an unsustainable high debt (SADC 2012). While energy consumption in the region has been helped by lower oil prices, this has adversely affected Angola's growth which is an oil producer and exporter (African Development Bank, 2018). As the preceding report argues however, the region's future growth will be strengthened by more investment in infrastructure projects including, but not limited to energy. All things being equal, SADC's Real GDP is expected to grow at a rate of 2.4 percent in 2019. This would be a considerable improvement from the 1.6 percent growth rate in 2017 and forecasted 2 percent growth rate in 2018 (ibid).

Table 2 below shows the income classification of SADC countries.

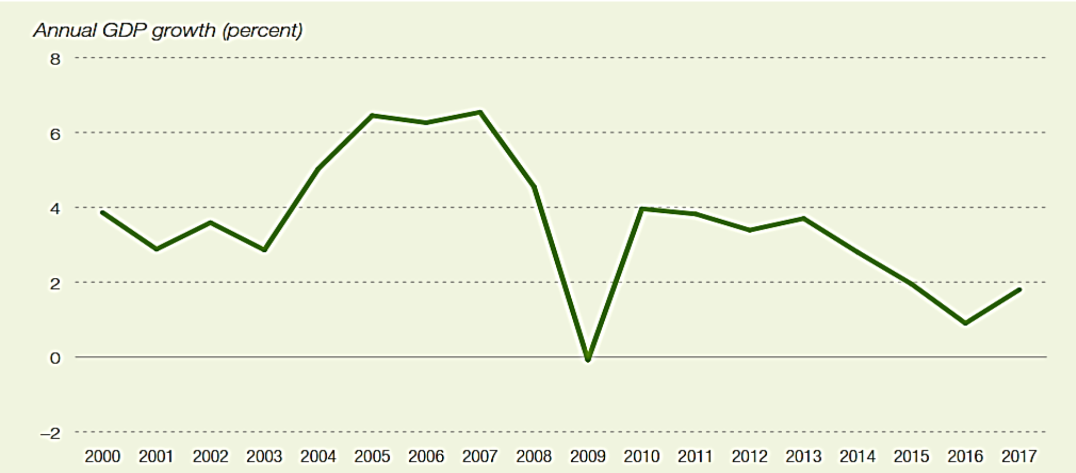
Table 2: Income Classification (SADC)

Income Group		SADC Country
Low		Lesotho Malawi Mozambique Tanzania Zambia Zimbabwe
Middle	Lower	Angola Botswana[3] Namibia Swaziland
	Upper	Mauritius South Africa

Source: The World Bank (1995)

The SADC region has experienced two different patterns of GDP growth over the past 20 years. Prior to the global crisis in 2008, the region experienced growth of 6.5 percent which was 0.5 percent less than the target of 7 percent (African Development Bank, 2018). However, after 2008 the region experienced a decline due to the global recession. Demand for the region's commodities declined, affecting exports. The region's growth has recovered but not at the same rate as the period before the global crisis. The growth experienced in the region has been led by the smaller economies which have posted moderate but consistent growth. South Africa has persistently posted the weakest growth in the region which has pulled down the region's average (African Development Bank, 2018). Figure 2 below shows SADC's average Real GDP growth.

Figure 2: Average Real GDP Growth (SADC)



Source: African Development Bank (2018)

On a sectoral basis, the key driver of GDP growth has been services such as tourism (ibid). Agriculture has declined due to effects of drought and diseases especially in countries such as Zambia and Zimbabwe. As such, countries such as Zimbabwe and Zambia are thus shifting from agriculture to services Therefore, while industry has traditionally been a key driver of GDP growth, it is also on a downward trend (African Development Bank, 2018).

It is important to note that while most SADC countries have agro-based economies, a transformation of the structure of regional economies from traditional sectors such as agriculture to value-added services is necessary to stimulate GDP growth in the medium to long-term (African Development Bank, 2018). Furthermore, it is of high importance that SADC countries invest in infrastructure such as electricity production to achieve and maintain high GDP growth. Figure 3 below sectoral GDP shares in SADC between 2000 and 2016.

Figure 3: Sectoral GDP (SADC)

	2000–06	2007–09	2010–13	2014–16
Services	47.0	48.6	55.0	57.6
Industry	30.8	31.0	27.3	24.9
Agriculture	22.2	20.4	17.7	17.5

Source: African Development Bank (2018)

The involvement of Development Finance Institutions (DFIs) in the region becomes of critical importance as governments do not have sufficient funds to invest in this sector. The role of Public Private Partnerships (PPPs) is also crucial to the financing and completion of large infrastructure projects such as those in the energy sector. DFIs and PPPs will be discussed in more detail in the next sections.

2.11 Development Finance Institutions (DFIs) Defined

Broadly speaking, a Development Bank is a financial intermediary which helps a country reach a higher and sustainable level of development (Banda, 2013). Development Banks or DFIs were established to finance development through providing funding for medium-term to long-term investments. By providing long-term financing, DFIs fill in the gap left by capital markets which are undeveloped and where commercial banks are reluctant to provide long-term financing (ibid). DFIs play a fundamental role in developing countries by acting as a catalyst to increase or sustain the levels of economic development in a country. Aside from capital, the ‘missing elements’ provided by DFIs in developing countries include, infrastructure, technology, foreign exchange and entrepreneurship (Banda, 2013). Thus, the processes of these banks are associated with agricultural, industrial, institutional, social, and other development strategies.

Developed countries have managed to develop these 'missing elements' which gives them a comparative advantage over lesser developed countries. For developing countries to achieve 'missing elements' in the shortest possible time, the input of DFIs is therefore of crucial importance. Private investor confidence is also boosted by the act of DFIs investing in a country. As such, DFIs bring credibility to countries which are perceived as having a high risk profile (Loos, 2013). Overall, DFIs are institutional instruments of public policy whose performance is measured in terms of benefits to society, as measured by means of indicators of social accounting, rather than the normal profit and loss (Banda, 2013). The United Nations (2005) identified three objectives for DFIs which include economic development, social objectives and regional integration. Table 3 below sums up these objectives.

Table 3: Three Objectives of DFIs

Objective	Examples of general cases	Examples of specific cases
Economic development *The 'common denominator' amongst NDBs*	Historically, development banks were first based on this objective. BancoEstado in Chile, one of the oldest Latin American development banks, was created in 1853 by an Organic Law stating the bank's objective as the offering of banking and financing services to encourage the "*development of national economic activity*".	Development banks can target specific sectors: the mission of the Banque agricole et commerciale du Burkina for instance is to foster "*agri-pastoral national development*". Banks can also serve one-time missions, such as in support of privatization processes.
Social objectives	The Brazilian Development Bank (BNDES) activities ought to result "*in greater social inclusion and the decrease of inequalities*". The Gabon Development Bank defines itself as the "*main instrument for Gabon's economic and social development*" and its project assessments therefore include social considerations. At the regional level, most RDBs pursue both economic and social development objectives. For instance, the IADB, the world's oldest RDB (1959), aims to "*contribute to the acceleration of the process of economic and social development of the regional developing member countries, individually and collectively*" (Charter of the IADB).	Some banks specifically concentrate on their social mission, such as the Council of Europe Development Bank (CEB, 1956) the only European financial institution with a purely social vocation.
Regional integration	Statutes can also include broader objectives of fostering regional integration. BNDES' activities for example ought to result also in "*the strengthening of national sovereignty and regional integration*".	Some banks specifically focus on regional aspects of development. The Banque Régionale de Solidarité (BRS SA) aims to fight poverty on a regional basis with coordinated efforts between participating West African countries. Some specifically foster on regional efforts to develop trade linkages – as Caricom and the Caribbean Development bank or the Andean countries and the CAF development bank since 1969, that both work in cooperation with NDBs.

Source: United Nations (2005)

2.11.1 The Role of SADC DFIs in Economic Growth and Infrastructure Development

Lack of infrastructure development in SADC has highlighted the importance of DFIs in this area. Economic growth and development in the region has been stifled by the lack of infrastructure due to funding problems (Monyae, 2011). The SADC Secretariat estimated that approximately US$20 billion to support the facilitation of trade and upgrading of regional infrastructure (Hagerman, 2012).

In SADC, DFIs are increasingly filling this gap. They are the main source of long-term loans, guarantees and other financial services in sectors of strategic importance to the economy, which include infrastructure, agriculture, housing and industry (Banda, 2014). The challenge for SADC DFIs is that 45 percent of them have total assets below US$100 million (Mpuku, 2014). This has limited the operations of most DFIs to just the national markets and only a few bigger institutions participate on a regional scale.

Table 4 sums up the total asset size of SADC's DFIs.

Table 4: Total Asset Size of SADC DFIs

Size US$mn	Number	%
<100	17	44.7
100 – 499	15	39.5
500 – 999	1	2.6
1000 - 1499	0	0
1500 - 1999	1	2.6
>2000	3	7.9
Total	37	100

Source: Mpuku (2014)

Mpuku (2014) observed that due to the small size of SADC DFIs, a majority are involved in sectors such as SME Financing, agriculture, industry and other sectors. Even so, infrastructure is not a major part of the portfolios of SADC DFIs. Mpuku (2014) further observed that SADC DFI resources are thinly spread because they participate in a number of sectors.

Table 5 presents the sectoral distribution of SADC's DFIs.

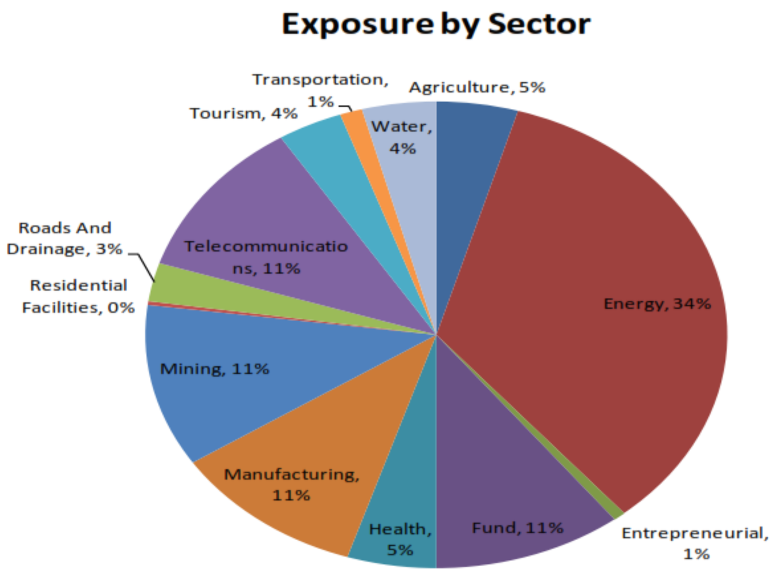
Table 5: Sectoral Distribution of SADC DFIs

Sector	No.	%
SME	13	34.2
Industry	8	21.0
Agriculture	6	15.8
Real Estate/Housing	3	7.9
Corporate	3	7.9
Infrastructure	3	7.9
Other	2	5.3
Total	38	100.0

Source: Mpuku (2014)

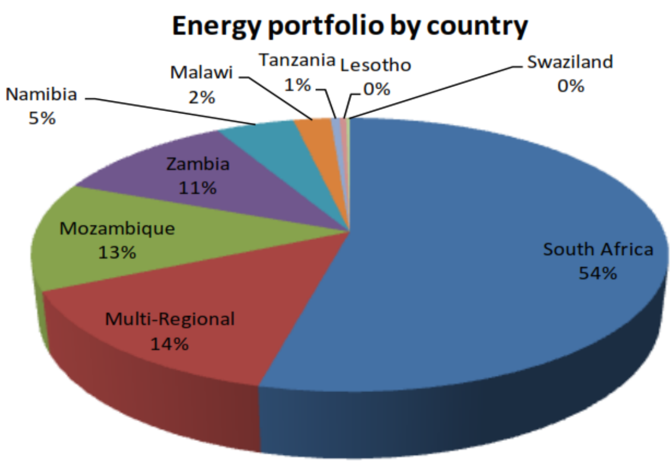
There are a small number of SADC DFIs that presently have a regional mandate. DFIs from South Africa, namely, the Development Bank of South Africa (DBSA) and the Industrial Development Corporation (IDC) are the key players in the infrastructure development of the region. Through these DFIs, the South African government is steering the regional infrastructure development projects for the SADC region (Monyae, 2011). Priorities for the two DFIs include strengthening regional energy integration (including the Southern African Power Pool) through financing projects linked to improvements in electricity interconnectors and exploring other opportunities for enhancing clean energy across the region. Since South Africa attained its independence in 1994, both the DBSA and IDC have grown their footprint significantly on the continent. The DBSA was established in 1983 and was given the mandate to promote economic growth through the development of infrastructure by acting as advisor, financier, implementer and partner (Madzongwe, 2010). Traditionally the two DFIs financed projects in South Africa alone, however the DBSA extended its mandate to include SADC in 1998, while the IDC extended its reach to the rest of the continent in the same year (Monyae, 2011). By 2009, the DBSA had given out infrastructural loans in 10 SADC countries which include Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Swaziland, Tanzania and Zambia (ibid). According to Madzongwe (2010), the bank had committed a third of its loan book to SADC projects. Of the total exposure in SADC, 34 percent was to the energy sector (ibid). This shows the importance of investment in energy infrastructure in the SADC region.

Figure 4: Total DBSA Exposure by Sector for SADC



Source: Madzongwe (2010)

Figure 5: DBSA Energy Portfolio by Country



Source: Madzongwe (2010)

As stated by Kargbo (2009) and Monyae (2011), in order to achieve the goal of infrastructure development and ultimately economic growth and development in the SADC region, SADC DFIs including the DBSA and IDC should:

1. Build a strong infrastructure knowledge base which involves an in-depth understanding of the infrastructure needs of the region.

2. Ensure that infrastructure projects which they have invested in benefit the ordinary man through job creation.
3. Support broad based economic empowerment of local people through partnering with local businesses.
4. Establish smart and strategic partnerships with counterpart DFIs in the developed countries.
5. Partner with the private sector and commercial banks to fast track infrastructure development in the region.
6. Encourage Public Private Partnerships (PPPs) as a form of risk sharing.
7. Mobilise resources from non-traditional sources of finance such as China, India and the Middle East.
8. Ensure that infrastructure projects adhere to the highest environmental protection standards.

2.11.2 Challenges faced by DFIs in SADC

DFIs in the SADC region have been affected by the following challenges:

a) Ownership Structure

Majority of SADC DFIs are highly reliant on government funding and decision-making (Mpuku, 2014). The results are that SADC governments exert pressure on DFIs over the appointment of senior management which in most cases are politically motivated rather than based on merit. Such influence by the state has hindered the development of these institutions into sustainable development finance institutions (Banda, 2014).

b) Poor Management and Political Interference

As most DFIs are State Owned Enterprises (SOEs) or state controlled, board autonomy from the government control is generally fragile (Mpuku, 2014). DFIs are sometimes swayed into supporting political agendas rather than genuine development causes (Banda, 2014). There are examples in SADC of problems faced by DFIs because funds were channelled to government projects which were uneconomical. Faced with unsustainable accumulated debt, governments have had to restructure the institutions (ibid).

c) Poor Business Models

DFIs have increasingly faced competition for financing from other players in the financial sector due to the deregulation of financial systems (Banda, 2014). The majority of DFIs do not take deposits, and this has added to the problem. Moreover, DFIs have also experienced problems in mobilizing external funds due to lack of sources of long-term financing which has led to high liquidity risk (Mpuku, 2014). On the lending side, commercial banks have provided increasing competition to DFIs as well as from other financial institutions that have established products and strategies to enter the space of long-term financing that was previously only DFIs occupied (Banda, 2014).

d) Failure to balance Public and Commercial Interests

Due to political influence and pressure to meet development goals, loans from DFIs have been treated as grants with no priority set for debt servicing by debtors. SADC DFIs have experienced significant asset and capital losses due to bad loan selection and poor monitoring and controls (Banda, 2014).

e) Weak Risk Management Systems and Practices

SADC DFIs have been characterized by weak risk management, loan follow-up and collection systems (Banda, 2014). These weak systems, which in most cases have not kept up with the business environment, have resulted in poor quality portfolios and high non-performing loans. Only a few DFIs in South Africa have restructured to be more commercially focused while majority of SADC DFIs lag behind (ibid).

f) Coordination of DFIs

Most SADC DFIs are established through Acts of Parliament and report directly to their line ministries. This has created a challenge in coordination and has slowed down decision making processes (Banda, 2014). Mpuku (2014) also highlights that DFIs should be supervised by Ministries of Finance rather than sectoral ministries such as agriculture, housing, industry, lands, trade, etc.

g) Nonexistent or Weak Regulation of DFIs

Most SADC DFIs are not regulated and the few that are face challenges which include inappropriate or weak regulatory policy frameworks. Thus, authorities have found it difficult to monitor, control and remedy issues faced by DFIs due to the lack of an overarching legal regulatory framework (Banda, 2014). It is recommended that DFIs be regulated by the Central Bank to ensure viability of the institutions (Mpuku, 2014). According to Mpuku (2014), only 31.3 percent of SADC DFIs are regulated by Central Banks with majority being institutions that are deposit taking.

2.11.3 Opportunities for SADC DFIs

In addition to challenges, there are a mixture of exogenous and endogenous factors which have presented some opportunities for DFIs in SADC. The table below shows the both sets of opportunities.

Table 6: Opportunities for DFIs

Exogenous and Endogenous Factors	Opportunities
1) GDP growth in the medium term is likely to be higher than in the recent past 2) Natural resources based sectors offer relatively high growth potential 3) Poorly developed physical infrastructure 4) Weak human development in the region 5) Impact of political instability on foreign capital flows. 6) Short-term orientation of banking system and shortages of long- term funds 7) Bank failures 8) High interest cost and high level of non-performing assets (NPAs). 9) Capital markets in embryonic stage. 10) Absence of supportive institutional framework in the financial sector. 11) Poor financial position of governments. 12) Privatization of state-owned enterprises underway.	1) More creditworthy borrowers and more lending opportunities due to productive sectors 2) Opportunities for DFIs to be self-sustaining by being commercially viable 3) Opportunity to develop local sources of steady and inexpensive long-term funds 4) Potential to influence the government policy and creation of an enabling environment 5) High business potential from financing of infrastructure projects 6) Good potential for agriculture, and natural resource based industries 7) Privatization process/limited competition provide good business opportunities for DFIs

Source: (Banda, 2014)

2.12 Public-Private Partnerships (PPPs)

In recent years, Public Private Partnerships (PPPs) have begun to be considered as one of the major methods used in undertaking infrastructure projects (Ibbs, 2009). PPPs can provide several benefits to the public sector which include, easing the financial burden on the public sector due to mounting infrastructure development costs, allowing risk to be shifted from the public to the private sector and increasing the value for money spent for infrastructure services by providing more efficient, lower cost, and reliable services (ibid). This is predominantly the case in developing countries where they have in recent times started trialling with collaborations between the public and private sectors (Jamali, 2004).

The table below explains the difference between public procurement, PPPs and private procurement.

Table 7: PPPs Explained

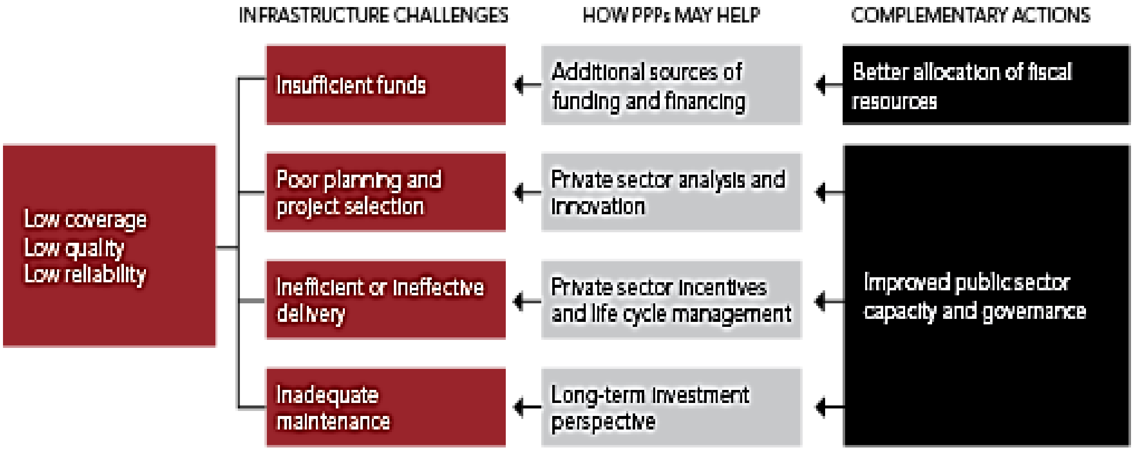
	Public procurement	*PPP*	*Full privatisation*
Definition	• Supply by the private sector of works, goods or service as defined by the public authority.	• PPPs introduce private sector efficiencies into public service by means of a long-term contractual arrangement. They secure all or part of the public service, call upon private funding and private sector know-how.	• Privatisation means transferring a public service or facility to the private sector, usually with ownership, for it to be managed in accordance with market forces and within a defined framework.
Main features	• Contracting authority establishes clearly what is to be built, how and by what means. • Invitations to tenders are accompanied by very detailed technical specifications regarding the type of work being procured. • Price quote is the single most important criterion in the evaluation of bids. • The procurement process is short-term in nature and does not involve long-term occupancy of infrastructure assets, and thus does not lay emphasis on the operational phase of the project.	• Contracting authority establishes the specifications of a project and leaves to the private sector the responsibility of proposing the best solution, subject to certain requirements. • Price is one of the many criteria in the evaluation of bids. A lot of emphasis is on the technical and financial capability of the bidder, financial arrangements proposed, and the reliability of technical solutions used. • Given the long duration of the concession period, emphasis is on the arrangements proposed for the operational phase.	• Privatisation authority prepares the divestment plan. • Involves transfer of ownership to the private sector. • Is generally a complex transaction with carefully designed contracts and a multi-stage competitive tender process. • Generally, the public sector withdraws from management of the entity on privatisation. • Almost all risks are borne by the private sector.

Source: Farlam (2005)

2.12.1 Benefits of PPPs

PPP contracts contain an incentive framework which allow for efficiency gains which should overshadow the extra costs associated with private finance. When government is unable to provide a service, and the PPP route is chosen, there are assurances that the PPP route will at least deliver the service required. (The World Bank, 2017). Thus, PPPs can help overcome challenges in infrastructure projects through assisting in the mobilisation of funds for projects as well as bringing a wealth of experience from the private sector. Countries with a long history of PPPs have discovered that these contracts manage construction projects reasonably well compared to traditional public procurement, with projects meeting deadlines and budgets repeatedly (ibid). This is due to the incentives brought about by the PPP structure, giving increased control to private parties over project design and implementation at the same time preventing cost overruns. PPP contracts have a long-term investment horizon which also helps to guarantee that assets are kept in good, working condition. Figure 5 below sums up the complementary role of PPPs.

Figure 6: Complementary role of PPPs summed up



Source: World Bank Group (2017)

2.12.2 Assessing PPPs in Africa

According to Farlam (2005), sub-Saharan Africa's infrastructure problems, notably, poor energy supply could be solved by PPPs. In SADC, governments recognise the importance of engaging private sector in infrastructure development. Thus, in 2011, they resolved that DFIS, SOEs and stakeholders create a SADC PPP network under the SADC Development Finance Resource Centre (Banda, 2014). The objectives of the PPP network were to include the facilitation of cooperation of policies and procedures that would encourage the implementation of PPPs for infrastructure development in the region (ibid). It was therefore determined through the RIDMP that there should be a harmonised PPP Investment Policy, Legal Framework and Institutional Arrangements to attract the participation of the private sector in infrastructure (Pillay, 2014). In 2013, SADC Ministers of Finance further approved a regional framework of PPPs which was developed by the PPP Network (ibid). The SADC Development Fund (DF) is the institution that was tasked with resource mobilisation to finance infrastructure projects. In his report titled, *Challenges to Regional Infrastructure Development*, Hagerman (2012) posed the following recommendations to address the challenges faced by PPPs and the private sector in SADC:

1. Support should be provided to institutions such as the SADC Development Finance Resource Centre (DFRC) to allow them to play a role in supporting key stakeholders to embark on PPPs.
2. Assessments should be carried out on African governments on their capacity to engage PPPs and find ways to strengthen their capacity.
3. Governments should have consultations with the private sector on the challenges they face when dealing with the public sector. The private sector needs to also understand challenges faced by governments. This information will assist in improving relations between the two parties.
4. Governments should take time in understanding the needs of investors and create an environment that will attract the desired quality investors.
5. Umbrella business groups should establish official forums, when necessary, which allow for engagement between the private and public sector.
6. Governments should gather information on best practices which will assist them in communicating and promoting PPPs to the general public.
7. Governments should institute centres of excellence that will educate government representatives on PPPs.

2.13 Summary of Chapter Two

A review of literature of the relationship between energy consumption and economic growth has shown that the relationship relies on other factors such as (1) substitution between energy and other inputs (2) technological change, (3) shifts in the composition of the energy input, and (4) shifts in the composition of output. Studies conducted on the relationship between the two variables have brought out different and sometimes conflicting results. Some studies concluded that there existed a bidirectional causality between the two variables, others concluded a unidirectional relationship existed while other studies have concluded no relationship exists between the variables. The different results obtained from the different studies are summarised by the following hypotheses: the neutrality hypothesis; the feedback hypothesis; the conservation hypothesis; and the growth hypothesis.

An overview of the energy in SADC countries, revealed that majority of the SADC population does not have access to electricity. Most SADC countries also have very low energy intensities, which is a measure of the energy inefficiency of a country. South Africa being the exception due to its more developed energy infrastructure. Despite these challenges, the region is rich in energy resources. There is huge hydro power potential, large coal fields and oil reserves in the region, huge biomass resources, and good solar potential.

The SADC countries developed the RIDMP which include the Energy Sector Plan, seeking to promote investment in energy and boost economic development. A minimum investment of US$114 billion was required between 2012 and 2017, for electricity generation. However, SADC countries face challenges in raising the necessary funding to achieve the ESP. Therefore, DFIs will need to play a significant role in filling the funding gaps that currently exist. PPPs are also a solution towards accessing private capital in developing the energy infrastructure in the region.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

This chapter provides a discussion on research methodology. The chapter outlines the conceptual framework and validates the selection of the research methodology used to analyse the correlation between energy usage and economic growth. This includes the criteria used for the selection of research participants from the target population as well as the sampling techniques applied in conducting the research. This chapter will also cover the data collection methods which were predominantly carried out using secondary data from databases.

3.2 Research Design

The study design followed a quantitative approach as explained by (Ott & Longnecker, 2015), in which it employed a relationship and causality test model of analysis. A quantitative approach involved prediction of variables and use of existing frameworks and exploitation of multiple numerical data sets. In this study, data was obtained mainly from secondary sources. Secondary data considered the Electricity consumption (kWh per capita) and GDP per capita (current US$) data that were accessed from the National Accounts Main Aggregates Database[1].

3.3 Population

The data was collected on an annual basis considering the GDP and Electricity consumption of Botswana, South Africa and Zimbabwe. The data was observed over a period of 34 years from 1981 to 2014. Thus, we came up with thirty-four sampling datasets totalling 204 observations. The research identified characteristics of the population as aggregates of GDP and electricity consumption that was reported over the 34 years. The annual data analysis was chosen as it gives a true picture of development within a given country in the most recent significant and measurable temporal scale.

[1] See https://unstats.un.org/unsd/snaama/Introduction.asp

3.4 Sample selection

Country GDP and electricity consumption were selected using a purposive sampling method (Palys, 2008). Out of fifteen countries in the SADC region, three were selected to extract the relevant data for the study. The inclusion criterion was based on the shared resources and energy business within countries. The countries under study were Botswana, South Africa and Zimbabwe. Since conventional random sampling design requires sampling points to be drawn from a sampling framework that consists of all countries within the region, the weakness of such a sampling framework for the SADC, is that, countries randomly selected will not guarantee direct representation of the industry performance or can result in oversampling. Alternatively, purposive sampling design was used to identify the optimal direct variance (correlation between energy usage and economic growth) within a minimum sample size. Purposive sampling was used to select the countries that show consistent records of data of GDP and electricity consumption from 1981 to 2014. Any country with missing data entries or zero records was excluded for sampling. Purposive sampling was most suitable for conducting this research in which generalisation was not the intended outcome due to the fact that it is prone to selection biases (Saunders, 2011; Wahyuni, 2012). Despite the shortcomings of this sampling method, it was observed that purposive sampling was the most suitable approach for selecting participants in this study because of its efficiency. The selection of this approach was premised on the fact that this study does not intend to generalise its findings to all countries.

3.5 Sample Size

The sample size of 204 annual data was considered statistically sufficient because a sample of 30 and above is perceived as sufficient for statistical analysis purposes (Green & Neil) especially in correlational and causality studies which involve regression. Moreover, the Central Limit Theorem undertakes that the greater the sample size the more it will assume a normal distribution (Kaneko, 1990).

3.6 Data Collection Procedure

Data collection was done using internet downloads from the United Nations Statistics Division and National Accounts Main Aggregates Database. The database presents a series of analytical national accounts tables from 1970 onwards for more than 200 countries and areas of the world. A spread sheet in Excel was prepared to capture secondary data sets from the database. Numerical figures from GDP and electricity consumption data sets were captured for analysis. The research identified the strengths of such an approach as it had potential to produce a representative picture of our research goal. The method used secondary data collection due to its ability to produce high quality data relevant for the study (Johnston, 2017). Additionally, the data parameters were used mainly because they were readily accessible and saved time and costs. In this approach, the researcher approached the selected country data, collecting data from credible database.

3.7 Measurements of Variables

The downloaded data sets of country GDP and electricity consumption were first tested for significance using granger causality test in RStudio software package (Soytas & Sari, 2003). It is largely understood that the Granger causality test is generally used to study causality relationships between two variables on a time series (Hurlin & Venet, 2001). It is a statistical hypothesis test that the researcher used to conclude if one variable affects the other. It was assumed that x and y are the two time-series variables (Shukur & Mantalos, 2000). Hiemstra and Jones (1994) showed that if "x causes y" "by means of a set of statistics, it indicates that the current y can be explained by past values of x and that adding lagged values of x to the model can enhance the explanation". In the first regression the null hypothesis states that "x does not Granger cause y". Equally, in the second regression the null hypothesis is that "y does not Granger cause x". The data was measured in terms of time series analyses in order to observe the trend pattern over years, data distribution and correlation (Pearson's correlation R). These measurements are important for correlational and causality studies which aim to observe relationships, influence and patterns in economic development within a spatial and temporal scale (Brovelli et al., 2004).

3.8 Data Collection and Analysis

Data sets for the variables under study were classified into three categories; (1) country GDP and (2) Electricity consumption. Data collected was cleaned and transformed into numerical format in Microsoft excel. The spread sheet was set into quantitative observational data before analysis using descriptive statistics, regression and time series and models. Quantitative methods were used to measure the causality relationship between country GDP and electricity consumption (Lee, 2006; Oh & Lee, 2004). The data derived from the records was analysed in R Studio and graphical representations were generated.

3.9 Ethical Considerations

Data collected for the study was for academic purposes only.

3.10 Limitations of the study

Complete energy consumption data within the SADC region was difficult to obtain for the selected period. There was only one data source which had the required data. The data was not however sufficient, as there was missing energy information for several SADC countries. This restricted the study to the selected countries. The data only covered the period 1981-2014, which means there was data missing for the four years up to 2018.

The generalizability of the study to the SADC region is therefore weak due to the statistical analysis being centred on three countries.

CHAPTER FOUR

4.0 RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents and analyses the findings of the research on the causality relationship between energy usage and economic growth in SADC. Chapter three presented the methodology that was used to gather data. The data sets obtained from the databases for analysis will be presented in tables and graphs. The research linked the data presentation to the research objectives outlined in Chapter 1 and the theoretical insight reviewed in Chapter 2 of the study.

4.2 Testing variables for statistical significance

The tests below will test the following hypotheses:

a. Null hypothesis (H0): Energy consumption (epc) cannot predict gross domestic production (gdp)
b. Alternative hypothesis (H1): Energy consumption (epc) can predict gross domestic production (gdp)

Table 8: Granger causality test for the variables GDP per capita Electricity consumption per capita for Botswana (epcBWA) from 1981-2014. The model was run to determine if changes in Electricity consumption influences GDP in Botswana (gdpBWA)

Model 1:	*gdpBWA ~ Lags(gdpBWA, 1:1) + Lags(epcBWA, 1:1)*					
Model 2:	*gdpBWA ~ Lags(gdpBWA, 1:1)*					
Res.Df	*Df*	*F*	*Pr(>F)*			
1	*30*					
2	*31*	*-1*	*0.001892*			
		11.603				
Signif. codes:	*0*	*0.001*	*0.01*	*0.05*	*0.1*	*1*

The above results for Botswana show the variables epcBWA and gdpBWA. The variable epcBWA represents Botswana Electricity Consumption and gdpBWA represents Botswana Gross Domestic Production per capita for the period 1981-2014. Granger causality test was used to determine if electricity consumption can predict Gross Domestic Production per capita values. Evidently, epcBWA granger causes gdpBWA as shown by a stronger p-value of 0.001892. Studies have shown that when p-value <0.05 data parameters are considered statistically significant (Rice, 1989; Storey & Tibshirani, 2003). Accordingly, the data sample is statistically sufficient and significant to determine GDP with accuracy when forecasting time series. Thus, we fail to reject the H1 that states epcBWA can predict gdpBWA values.

Table 9: Granger causality test for the variables GDP per capita and Electricity consumption per capita for South Africa from 1981-2014. The model was run to determine if changes in Electricity consumption influences GDP in South Africa.

Model 1:	*gdpRSA ~ Lags(gdpRSA, 1:1) + Lags(epcRSA, 1:1)*					
Model 2:	*gdpRSA ~ Lags(gdpRSA, 1:1)*					
Res.Df	*Df*	*F*	*Pr(>F)*			
1	*30*					
2	*31*	-1	0.2776			
		1.2229				
Signif. codes:	*0*	*0.001*	*0.01*	*0.05*	*0.1*	*1*

The above results for South Africa show the variables epcRSA and gdpRSA. The variable epcRSA represents South Africa's Electricity consumption and gdpRSA represents South Africa's Gross Domestic Production per capita for the period 1981-2014. Granger causality test was used to determine if electricity consumption can predict Gross Domestic Production per capita values. Evidently, epcRSA does not granger cause gdpRSA as shown by a weaker p-value of 0.2776. When the p-value > 0.05 is considered statistically insignificant. Accordingly, the data sample is statistically insufficient and insignificant to determine GDP with accuracy when forecasting time series. Thus, we fail to reject the H0 that states epcRSA cannot predict gdpRSA values.

Table 10: Granger causality test for the variables GDP per capita and Electricity consumption per capita for Zimbabwe from 1981-2014. The model was run to determine if changes in Electricity consumption influences GDP in Zimbabwe.

Model 1:	*gdpZWE ~ Lags(gdpZWE, 1:1) + Lags(epcZWE, 1:1)*					
Model 2:	*gdpZWE ~ Lags(gdpZWE, 1:1)*					
Res.Df	***Df***	***F***	***Pr(>F)***			
1	*30*					
2	*31*	-1 10.99	0.002403			
Signif. codes:	*0*	*0.001*	*0.01*	*0.05*	*0.1*	*1*

The above results for Zimbabwe show the variables epcZWE and gdpZWE. The variable epcZWE represents Zimbabwe Electricity consumption and gdpZWE represents Zimbabwe Gross Domestic Production per capita for the period 1981-2014. Granger causality test was used to determine if electricity consumption can predict Gross Domestic Production per capita values. Evidently, epcZWE granger causes gdpZWE as shown by a stronger p-value of 0.002403. Studies have shown that, p-value <0.05 is considered statistically significant to conduct analyses. Accordingly, the data sample is statistically sufficient and significant to determine GDP with accuracy when forecasting time series. Thus, we fail to reject the H1 that states epcZWE can predict gdpZWE values.

Table 11: Descriptive statistics: GDP by country for the years 1981-2014

Country	**Obs**	**Mean**	**Median**	**Standard Deviation**	**Sample Variance**	**Kurtosis**	**Skewness**	**Range**	**Min**	**Max**	**Sum**	**Confidence Level (95.0 percent)**
Botswana	34	3605.12913	3038.89757	2024.301	4097796	-0.73383	0.536284	6707.74	937.4745	7645.215	122574.4	706.3121
South Africa	34	4096.27016	3404.39938	1666.506	2777242	-0.27978	0.995595	5924.638	2051.828	7976.466	139273.2	581.47142
Zimbabwe	34	696.627172	671.85348	208.0884	43300.8	-0.69409	0.303731	780.2802	325.6786	1105.959	23685.32	72.605491

Variable Gross Domestic Product represents GDP at purchaser's prices for the three SADC countries, Botswana, South Africa and Zimbabwe observed from 1981-2014. The variable is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Evidently, the table shows 34 observations with significant differences between minimum and maximum observed variables. This shows that there is variation in the value of products by country. Comparatively, GDP in South Africa is greater than Botswana and Zimbabwe. Accordingly, high maximum values of Botswana and South Africa suggests stronger working economies that are characterized by production and exports than consumption and imports as in the case of Zimbabwe.

Table 12: Descriptive statistics: Energy Power Consumption by country for the years 1981-2014

Country	Obs	Mean	Median	Standard Deviation	Sample Variance	Kurtosis	Skewness	Range	Min	Max	Sum	Confidence Level (95.0 percent)
Botswana	34	1086.55	992.5	417.955	174686	-0.80031	0.47589	1534.79	525.8105	2060.6	36942.76	145.8313
South Africa	34	4254.33	4252.9	321.375	103282	-0.40555	-0.4537	1242.75	3534.312	4777.06	144647.2	112.1331
Zimbabwe	34	797.215	840.4	139.001	19321.4	-0.38857	-0.9731	446.227	531.0414	977.268	27105.3	48.49983

Variable Energy Power Consumption represents Electricity consumption (kWh per capita) for three SADC countries, Botswana, South Africa and Zimbabwe observed from 1981-2014. Evidently, the table shows 34 observations with significant differences between minimum and maximum observed variables. This shows that there is variation of energy consumption by country. Comparatively, energy use in South Africa is greater than Botswana and Zimbabwe. Accordingly, high maximum values of Botswana and South Africa suggests greater production channels or energy investments compared to Zimbabwe.

4.3 Trend analysis for the three SADC countries

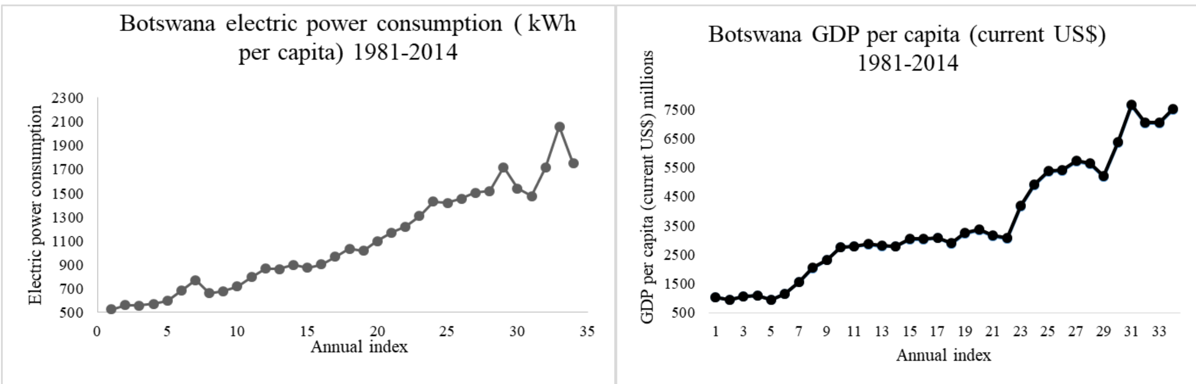


Figure 7: Graphs showing Time series analysis for Electricity consumption and GDP per capita in Botswana

The graphs above show the trend behaviour of Electricity consumption and GDP for Botswana from 1981 to 2014. The time series shows a positive linear pattern with some unidirectional annual increase however without seasonality. The results show that Electricity consumption has increased by 3.92 times in Botswana from 1981-2014. Comparatively, GDP has increased by 8.16 times during the same period from 1981-2014. We can see a corresponding relationship between economic growth and energy consumption over time.

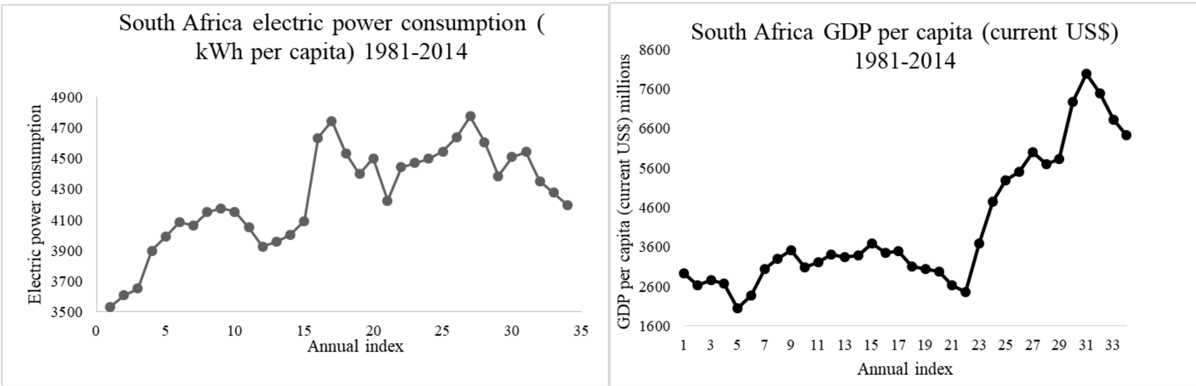


Figure 8: Graphs showing Time series analysis for Electricity consumption and GDP per capita in South Africa from 1981-2014

The graphs above show the trend behaviour of Electricity consumption and GDP for South Africa from 1981 to 2014. The time series shows an irregular pattern as well as unidirectional annual increase. The results showed no significant change in Electricity consumption which showed 1.4 times increase in South Africa from 1981-2014. Comparatively, GDP has increased by 3.9 times during the same period from 1981-2014.

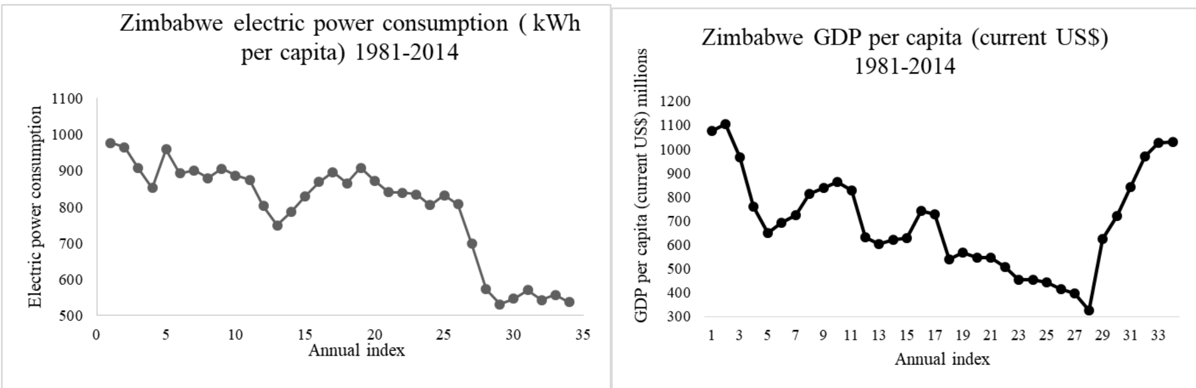


Figure 9: Graphs showing Time series analysis for Electricity consumption and GDP per capita in Zimbabwe from 1981-2014

The graphs above show the trend behaviour of Electricity consumption and GDP for Zimbabwe from 1981 to 2014. The time series show an irregular pattern that is characterized by a negative trend showing a unidirectional annual decrease. The results show that Electricity consumption has decreased by 1.8 times in Zimbabwe from 1981-2014. Comparatively, GDP has decreased by 3.67 times during the same period from 1981-2014.

We can see a corresponding relationship between economic growth and energy consumption over time.

The graphs below show the two indicators, Electricity consumption Kw per capita and GDP per capita, measured in time series for the period 1981-2014. Although the above graphs cannot explain correlation, the granger causality test showed that there is strong causality of Electricity consumption on GDP per capita. South Africa showed neither relationship nor causality in both parameters under study.

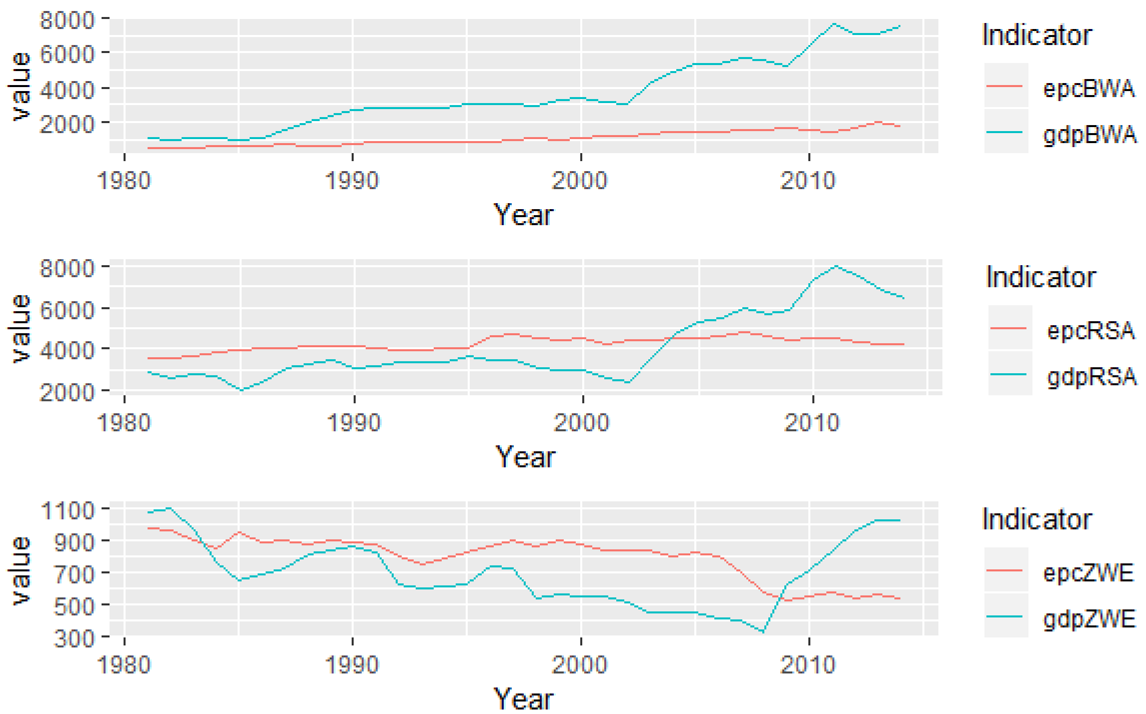


Figure 10: Graphs showing Time series analysis for Electricity consumption and GDP per capita in all the countries under study from 1981-2014

The scatter plot below shows a very strong and positive linear relationship between GDP per capita and Electricity consumption per capita for Botswana from 1981-2014. The R2 is 0.8893 and is above 0.75 which shows a very strong relationship between the two variables. Accordingly, a positive correlation exists between the two variables in Botswana.

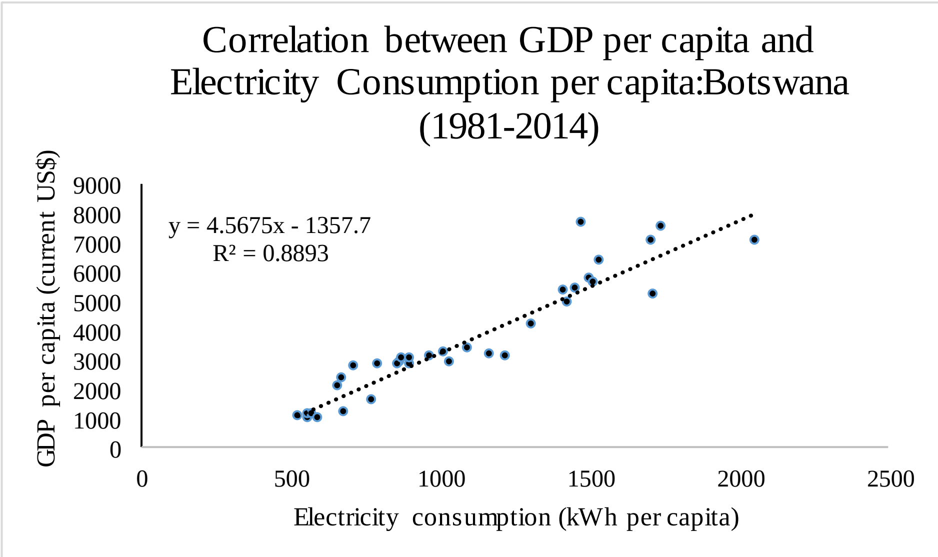


Figure 11: A scatter plot showing correlation between GDP per capita and Electricity consumption per capita for Botswana from 1981-2014

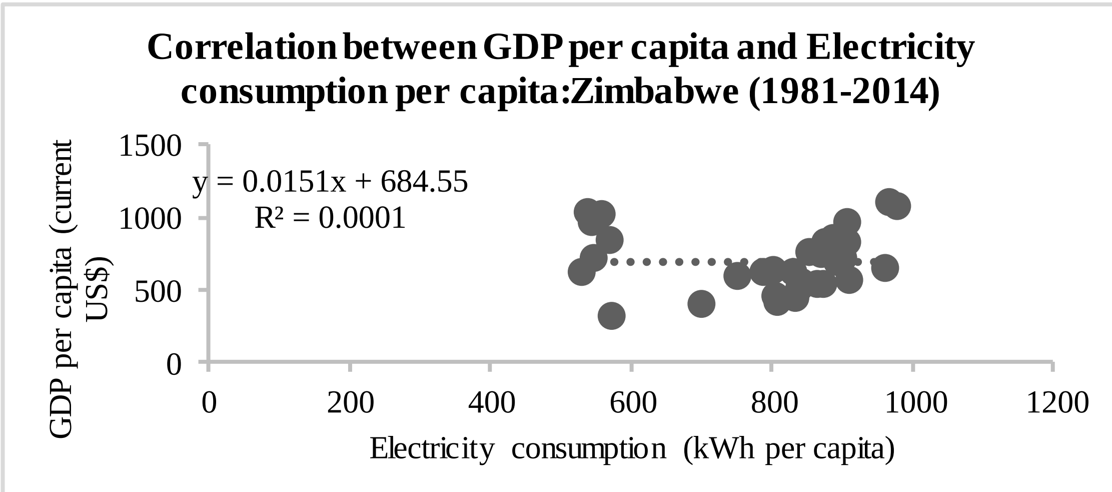


Figure 12: A scatter plot showing correlation between GDP per capita and Electricity consumption per capita for South Africa from 1981-2014

The scatter plot above shows a weak relationship between GDP per capita and Electricity consumption per capita for South Africa from 1981-2014. The R2 is 0.2385 and is below 0.75 which shows a very weak relationship between the two variables. Accordingly, there exists no correlation between the two variables in South Africa.

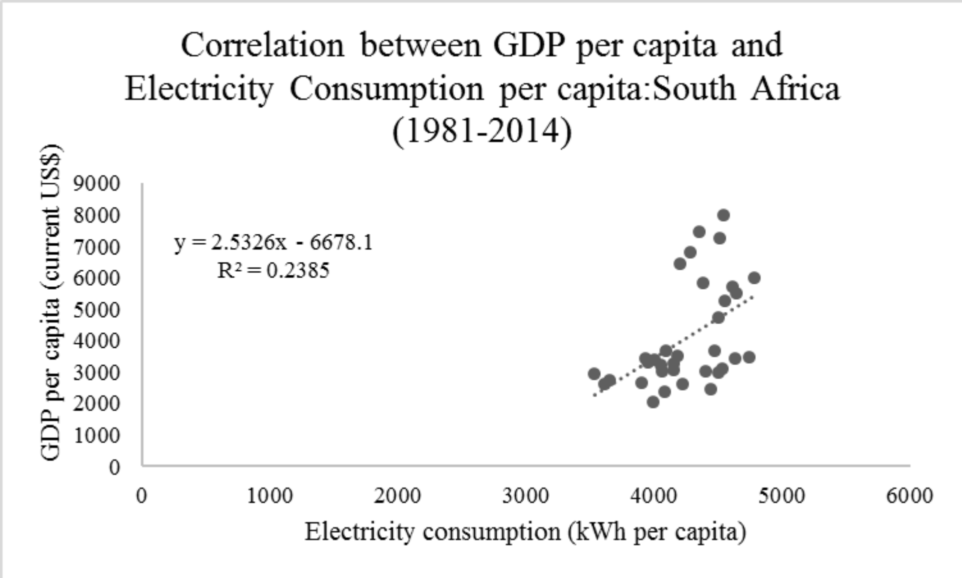


Figure 13: A scatter plot showing correlation between GDP per capita and Electricity consumption per capita for Zimbabwe from 1981-2014

The scatter plot above shows a very weak and negative linear relationship between GDP per capita and Electricity consumption per capita for Zimbabwe from 1981-2014. The R2 is 0.0001 and is below 0.75 which shows a very weak relationship between the two variables. Accordingly, a negative linear relationship exist between the two variables in Zimbabwe.

4.4 Forecasting GDP per capita and Electricity consumption per capita for Botswana and Zimbabwe + 5years from 2015-2019

In this section the study attempted to address the research objective which aimed at forecasting the variables under study. Since the variables for South Africa did not show any significance for analysis following the granger causality test, the researcher negated the need for its analysis. Thus we modeled time series plots for Botswana and Zimbabwe for only five years and shown in figure 13 to figure 16 below.

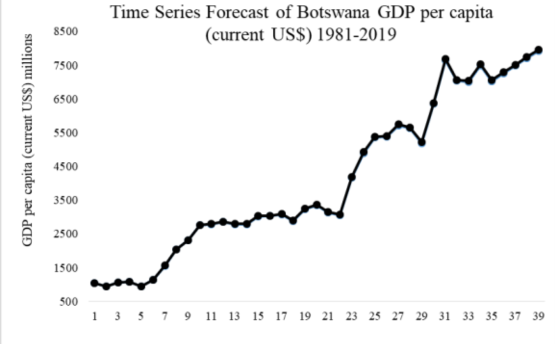


Figure 15: Time series forecast plot for Botswana GDP per capita

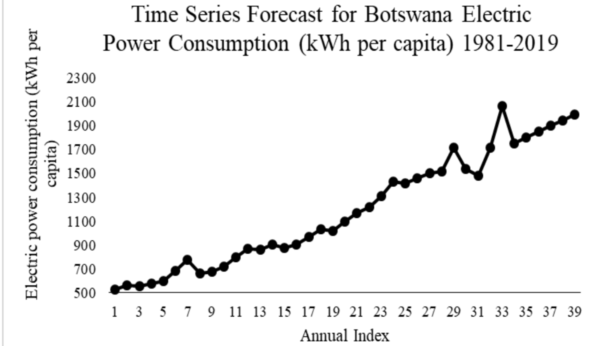


Figure 14: Time series forecast plot for Botswana Electric Power Consumption per capita

Figure 14 and Figure 15 shows a time series forecast plot for Botswana showing a very strong positive linear pattern in both GDP per capita and electric power consumption in the last five years.

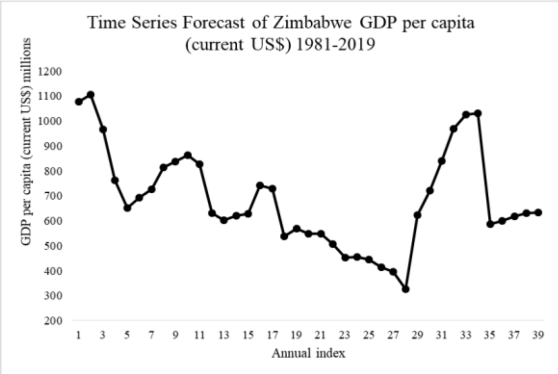


Figure 16: Time series forecast plot for Zimbabwe GDP per capita

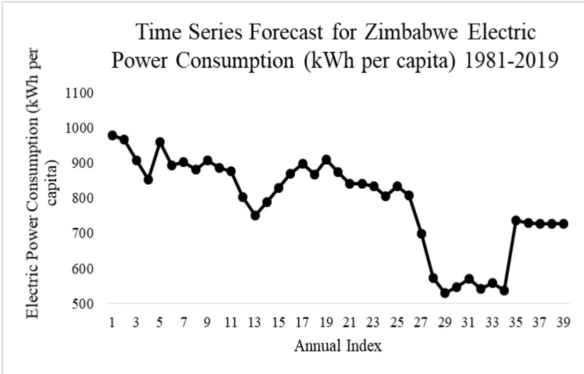


Figure 17: Time series forecast plot for Zimbabwe Electric Power Consumption per capita

Figure 16 and Figure 17 show a time series forecast plot for Zimbabwe showing a very weak and negative linear pattern in both GDP per capita and electric power consumption per capita in the last five years. Overall, the results confirmed that, in the short-term, there existed a bidirectional causality relationship between GDP per capita and electric power consumption per capita, and in the long-term a unidirectional relationship running from GDP per capita to electric power consumption per capita. These results are in line with the feedback and conversation hypothesis. In the short-term where a bidirectional causality exists, the feedback hypothesis holds true, suggesting that energy consumption and GDP per capita are independent variables that affect each other. In the long-term unidirectional relationship, the conversation hypothesis holds true which suggests GDP per capita or level of economic activity affects energy consumption.

4.5 Summary Chapter Four: Empirical Results and Discussion

In Chapter 2, there was a discussion on the factors which affect the linkage between energy consumption and economic growth. Applying these factors to the findings of the study, it can be concluded that the factors that affect the linkage in SADC are (1) energy efficiency and technological change and (2) energy quality and economic growth. The study shows that energy consumption in South Africa is higher than in Botswana and Zimbabwe. The expectation would be that the differences in GDP per capita would be reflective of the differences in energy consumption, however this is not the case. The difference between GDP per capita between South Africa and Botswana is smaller than the variance in electricity consumption between the two countries. This could be explained by the energy efficiency and technological change factor, where Botswana could be utilising its energy with minimal loss and optimum efficiency as compared to South Africa. The energy intensity for Botswana also seems higher as the country is consuming less energy per GDP per capita.

Zimbabwe has the lowest GDP per capita and energy consumption of all the three countries which could be explained by the energy quality and economic growth factor. Electricity produces highest quality of energy meaning that the energy required to produce a dollar of GDP from electricity is less than that from other fuels. Improving energy quality reduces the energy intensity. Zimbabwe has faced economic challenges over the past two decades that have affected electricity production and consumption. The primary source of energy is biomass, with two thirds of the population using wood as a source of energy. This has an impact on the economic growth of the country as evidenced by the findings of the study. Botswana and South Africa have higher electricity access than Zimbabwe which is evidenced by the higher GDP per capita.

In terms of funding mechanisms for energy development in SADC, the findings suggest that, more funding is required to ensure universal access to affordable electricity that is clean, across the region. The theme of universal access to affordable clean energy sources (SDG7) is among the global aspirations targeted at improving the quality of life for all people, while maintaining healthy environments, to achieve sustainable development. Expanding energy infrastructure and upgrading technology, not only boosts energy consumption, but encourages economic growth too. While SADC governments have been noted to be the major funders for energy development at country level (Chapter 2), the contribution of DFIs in regional energy integration cannot be ignored. However, SADC could benefit more from collaborations between DFIs and PPPs to quicken the rate of energy supply across the region. Provisions for attracting the participation of the private sector in infrastructure where laid out in the RIDMP and now need to be followed through by action.

The results in this chapter inform the conclusions drawn from this study and also form the basis of policy recommendations and recommendations for future research.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMEDATIONS

5.1 Introduction

This final chapter summarizes the study from the literature review, the research methodology and research findings. The second part will present policy recommendations and suggestions for future research.

5.2 Summary of the study and Conclusions

The primary objective of the study was to investigate the correlation between energy consumption and economic growth in SADC over a defined period of time. Using a time series analysis, the study analysed energy consumption and economic growth trends between 1980 and 2016, a period of 34 years. The secondary data was collated online from the United Nations Statistics Division and National Accounts Main Aggregates Database. The study sort to establish a relationship between the two variables in a sample of three SADC countries, Botswana, South Africa and Zimbabwe. Purposive sampling was applied to select the three countries from a population of fifteen SADC countries. It was observed that purposive sampling was the most suitable approach for selecting participants in this study because of its efficiency.

The study started by testing the data for statistical significance by conducting a Granger causality test. This was to test the causality relationship between country GDP and electricity consumption for Botswana, Zimbabwe and South Africa. The Granger causality test was applied to determine if electricity consumption can predict GDP per capita for the three countries. The results of the test showed that there was a causality relationship between the two variables for Botswana and Zimbabwe. In these two cases the growth hypothesis holds true as the causality is running from energy consumption to economic output, suggesting that energy is a key input in all phases of production and can indeed impact on economic growth. However, the causal relationship did not exist in the case of South Africa. In South Africa where no causality was found, the neutrality hypothesis is confirmed. This implies that economic growth will not decrease due to energy conservation and economic growth will not stimulate energy consumption.

A time series analysis, for the period 1981-2014, between energy consumption and country GDP for the three countries was then conducted. For Botswana the time series analysis showed a positive linear pattern with some unidirectional annual increase for both energy consumption and country GDP. This shows that there is a corresponding relationship between economic growth and energy consumption. The graphs for South Africa showed an irregular pattern as well as unidirectional annual increase. There was no relationship between energy consumption and economic growth. In the case of Zimbabwe, the graphs show that both electricity consumption and GDP increased over the period of the study. This shows a corresponding relationship between economic growth and energy consumption.

The test for correlation revealed that there was a strong and positive correlation between GDP per capita and electricity consumption per capita for Botswana from 1981-2014. The relationship between the two variables was very weak for South Africa, indicating that there exists no correlation. For Zimbabwe the graph showed a very weak and negative linear relationship between the two variables. Which means there was no correlation between the two variables.

The study also attempted to forecast for 5 years the two variables under study. Since the variables for South Africa did not show any significance for analysis following the Granger causality test, the researcher negated the need for analysis. Overall, the results revealed that, in the short run, there was a bidirectional causality relationship between GDP per capita and electric power consumption per capita, and in the long run a unidirectional relationship running from GDP per capita to electric power consumption per capita.

5.3 Policy Recommendations

The overall findings of this study validate that electricity consumption and supply stimulates economic growth. Therefore, improvements in electricity supply is necessary for the enhancement of the economies of SADC countries. Governments in SADC member countries should put in policies for the improvement of electricity supply industries. This will allow more players to participate in the industry through structures such as public private partnerships (PPPs). There is need for governments to provide support to institutions such as the SADC DFRC in their role in supporting stakeholders embarking on PPPs. For PPPs to be successful, governments and the private sector need to improve their relations by understanding the challenges faced by either party. Governments should also create an environment that will attract quality investors and create institutions that educate government representatives on PPPs. SADC countries are lagging behind developed countries in terms of economic growth. In order to achieve and sustain economic growth rates that are high, it is essential for SADC countries to formulate policies for improving the effectiveness of financial systems in organising and distributing resources for investments in the long-term. This will unlock the potential of infrastructure sectors which include energy supply. Development Finance Institutions (DFIs) in SADC need to play a more significant role and be increasingly effective in filling the funding gap left by commercial banks. There is need for governments to strengthen national DFIs so that they are able to play a significant role in financing infrastructure projects at a national level. Poor national infrastructure can be an obstacle to the development of projects of a regional scale such as electricity generation projects (Kargbo, 2009). DFIs should enter into strategic partnerships with other DFIs, private sector and commercial banks to fast track infrastructure development in the region.

5.4 Recommendations for future research

A recommendation for future research which needs to be addressed is the availability of data from SADC sources. The data used was obtained from international data sources rather than from SADC sources of individual SADC countries, for the inter-company comparisons. Questions could be raised whether the data tallies with that of the SADC countries. The data might tally; however different methodologies might have been used to collect the data which could raise issues with reconciling the methodologies. It is therefore important for SADC to invest in data centres which collate accurate and comprehensive data on its member states.

REFERENCES

Al-Mulali, U. (2011). Oil consumption, CO2 emission and economic growth in MENA countries. Energy, 36(10), 6165–6171.

Al-Mulali, U., & Sab, C. N. B. C. (2012). The impact of energy consumption and CO 2 emission on the economic growth and financial development in the Sub-Saharan African countries. Energy, 36(1), 180–186.

Apostolakis, B. E. (1990). Energy-capital substitutability / complementarity: the dichotomy. Energy Economics, 12, 48–58.

Banda, L. (2013). Study on Scan of SADC Development Finance Institutions' Environment.

Banda, L. (2014). A Scan of National Development Finance Institutions in the SADC Region.

Brovelli, A., Ding, M., Ledberg, A., Chen, Y., Nakamura, R., & Bressler, S. L. (2004). Beta oscillations in a large-scale sensorimotor cortical network: directional influences revealed by Granger causality. Proceedings of the National Academy of Sciences, 101(26), 9849-9854.

Brown, J. H., et al. (2011). "Energetic limits to economic growth." BioScience 61(1): 19-26.

Brown, J. H., et al. (2011). "Energetic Limits to Growth." BioScience 61(1): 19-26.

Calice, P. (2013). African Development Finance Institutions: Unlocking the Potential, (174), 1–40. Retrieved from http://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Working Paper 174 - African Development Finance Institutions- Unlocking the Potential.pdf

Costantini, V., & Paglialunga, E. (2014). Elasticity of substitution in capital-energy relationships: how central is a sector-based panel estimation approach?, 1–38. Retrieved from http://www.sustainability-seeds.org/papers/RePec/srt/wpaper/1314.pdf%0Ahttp://www.sustainability-seeds.org/

Davidson, O., & Mwakasonda, S. A. (2004). Electricity access for the poor: a study of South Africa and Zimbabwe. Energy for Sustainable Development, 8(4), 26–40. https://doi.org/10.1016/S0973-0826(08)60511-6

Davidson, O. and S. A. Mwakasonda (2004). "Electricity access for the poor: a study of South Africa and Zimbabwe." Energy for Sustainable Development 8(4): 26-40.

Dube, M. (2013). Case Study 3: Analysing the Development Process for Infrastructure Projects in SADC. Maastricht, The Netherlands: European Centre for Development Policy Management (ECDPM). Retrieved from http://ecdpm.org/wp-content/uploads/2013-PERISA-CaseStudy3-Analysing-Development-Process-Infrastructure-Projects-SADC.pdf

Eberhard, A., Rosnes, O., Shkaratan, M., & Vennemo, H. (2011). Africa’s power infrastructure: investment, integration, efficiency. Washington D.C.: The World Bank.

Eberhard, A., et al. (2011). Africa's power infrastructure: investment, integration, efficiency, The World Bank.

Esen, Ö., & Bayrak, M. (2017a). Does more energy consumption support economic growth in net energy-importing countries? Journal of Economics, Finance and Administrative Science, 22(42), 75–98. https://doi.org/10.1108/JEFAS-01-2017-0015

Esen, Ö., & Bayrak, M. (2017b). Does more energy consumption support economic growth in net energy-importing countries? Journal of Economics, Finance and Administrative Science, 22(42), 75–98. https://doi.org/10.1108/JEFAS-01-2017-0015

Farlam, P. (2005). Assessing Public – Private Partnerships in Africa. Pretoria: The South African Institute of International Affairs.

Frondel, M., & Schmidt, C. M. (2002). The capital-energy controversy: An artifact of cost shares? The Energy Journal, 23(3), 53–79.

Gamula, G. E. T., Hui, L., & Peng, W. (2014). An Overview of the Energy Sector in Malawi. International Journal of Sustainable Energy Development, 3(1), 115–126. https://doi.org/10.20533/ijsed.2046.3707.2014.0017

Green, S. B., & Neil, J. Salkind. 2008. Using SPSS for Windows and Macintosh: Analyzing and understanding data, 5.

Hiemstra, C., & Jones, J. D. (1994). Testing for linear and nonlinear Granger causality in the stock price-volume relation. The Journal of Finance, 49(5), 1639-1664.

Hinds, R. (2015). Political economy of energy in southern Africa. Retrieved from http://www.gsdrc.org/docs/open/hdq1197.pdf

Hivos. (2010). Zambia: Energy Profile, (Iea 2009). Retrieved from https://www.hivos.org/sites/default/files/rwanda_profile.pdf

Hurlin, C., & Venet, B. (2001). Granger causality tests in panel data models with fixed coefficients. Cahier de Recherche EURISCO, September, Université Paris IX Dauphine.

Ibbs, C. W. (2009). Towards a Comprehensive Understanding of Public Private Partnerships for Infrastructure Development, 51(2), 51–78.

Jackson, J. (2013). Dreaming Big. Terraviva, 1–8.

Jakovac, P. (2004). Causality between Energy Consumption and Economic Growth, (Discussion Paper #D-24/2004), 1–31.

Jamali, D. (2004). Success and failure mechanisms of public private partnerships (PPPs) in developing countries. Insights from the Lebanese context. International Journal of Public Sector Management, 17(5), 414–430. https://doi.org/10.1108/09513550410546598

Johnston, M. P. (2017). Secondary data analysis: A method of which the time has come. Qualitative and Quantitative Methods in Libraries, 3(3), 619-626.

Kaneko, K. (1990). Globally coupled chaos violates the law of large numbers but not the central-limit theorem. Physical review letters, 65(12), 1391.

Kaufmann, R. K. (2004). The mechanisms for autonomous energy efficiency increases: A cointegration analysis of the US energy/GDP ratio. Energy Journal, 25(1), 63–86.

Kebede, E., Kagochi, J., & Jolly, C. M. (2010). Energy consumption and economic development in Sub-Sahara Africa. Energy Economics, 32(3), 532–537. https://doi.org/10.1016/j.eneco.2010.02.003

Khadiagala, G. M. (2011). The Role of Development Finance Institutions (DFI) in Building South Africa's Developmental State. Midrand. https://doi.org/10.13140/RG.2.1.4945.9042

Kusakana, K. (2016). A Review of Energy in the Democratic Republic of Congo. International Journal of Energy and Power Engineering, 10(6). Retrieved from https://waset.org/abstracts/48786%0Ahttps://www.researchgate.net/publication/306380971_A_Review_of_Energy_in_the_Democratic_Republic_of_Congo

Kraft, J. and A. Kraft (1978). "On the Relationship between Energy and GNP." Journal of

Energy and Development 3(2): 401-403.

Lee, C.-C. (2006). The causality relationship between energy consumption and GDP in G-11 countries revisited. Energy policy, 34(9), 1086-1093.

Loos, U. (2013). Development finance institutions and private equity investment In Africa, (February). Retrieved from http://gsblibrary.uct.ac.za/researchreports/2010/loos.pdf

Lukamba-Muhiya, J. M., & Uken, E. (2006). The electricity supply industry in the Democratic Republic of the Congo. Journal of Energy in Southern Africa, 17(3), 21–28.

Makonese, T. (2016). Renewable energy in Zimbabwe. Proceedings of the 24th Conference on the Domestic Use of Energy, DUE 2016, (March 2016). https://doi.org/10.1109/DUE.2016.7466713

Matyelele, C. (2013). Current Status of Energy Sector in Tanzania. In Executive Exchange On Developing An Ancillary Service Market. Washington D.C. 25 February - 2 March 2013: USEA.

Merven, B., et al. (2010). "An analysis of energy consumption for a selection of countries in the Southern African Development Community." Journal of Energy in Southern Africa 21(1): 11-24.

Oh, W., & Lee, K. (2004). Causal relationship between energy consumption and GDP revisited: the case of Korea 1970–1999. Energy economics, 26(1), 51-59.

Omri, A. (2013). CO2 emissions, energy consumption and economic growth nexus in MENA countries: Evidence from simultaneous equations models. Energy Economics, 40, 657664.

Ott, R. L., & Longnecker, M. T. (2015). An introduction to statistical methods and data analysis: Nelson Education.

Palys, T. (2008). Purposive sampling. The Sage encyclopedia of qualitative research methods, 2(1), 697-698.

Panayotou, T. (1993). Empirical Tests and Policy Analysis of Environmental Degradation at Different Stages of Economic Development. (No. 238) Technology and Employment Programme Working paper, International Labour Office, Geneva.

Raskin, P., & Lazarus, M. (1991). Regional Energy Development in Southern Africa: Great Potential, Great Constraints. Annual Review Energy Environment, 16, 145–178.

REEGLE. (2012). Seychelles Energy Overview. Vienna.

SADC. (2001). Regional Indicative Strategic Development Plan. https://doi.org/10.1126/science.286.5438.229a

SADC. (2011). SADC Statistics Yearbook 2011. Retrieved from http://www.sadc.int/information-services/sadc-statistics/sadc-statiyearbook/

SADC. (2012). Regional infrastructure development master plan. Retrieved from http://www.sadc.int/files/7513/5293/3530/Regional_Infrastructure_Development_Master_Plan_Executive_Summary.pdf

SADC. (2013). SADC Regional Infrastructure Development Master Plan. Southern African Development Community, (August). https://doi.org/10.1002/ejoc.201200111

Saunders, M. N. (2011). Research methods for business students, 5/e: Pearson Education India.

Schreiner, M., & Yaron, J. (2001). Development finance institutions: measuring their subsidy. Washington, D.C.: The World Bank.

Schurr, S., & Netschert, B. (1960). Energy and the American Economy, 1850-1975. Baltimore: Johns Hopkins University Press.

Shukur, G., & Mantalos, P. (2000). A simple investigation of the Granger-causality test in integrated-cointegrated VAR systems. Journal of Applied Statistics, 27(8), 1021-1031.

Southern African Development Community (SADC). (2012). Regional Infrastructure Development Master Plan, Energy Sector Plan. Retrieved from http://www.sadc.int/files/9313/5293/3536/Regional_Infrastructure_Development_Master_Plan_Transport_Sector_Plan.pdf

Soytas, U., & Sari, R. (2003). Energy consumption and GDP: causality relationship in G-7 countries and emerging markets. Energy economics, 25(1), 33-37.

Stern, D. I., & Cleveland, C. J. (2004). Energy and Economic Growth (No. 0410). New York.

Storey, J. D., & Tibshirani, R. (2003). Statistical significance for genomewide studies.

Proceedings of the National Academy of Sciences, 100(16), 9440-9445.

Rice, W. R. (1989). Analyzing tables of statistical tests. Evolution, 43(1), 223-225.

The World Bank. (2015). Republic of Mozambique Energy Sector Policy Note, 1686–1699. https://doi.org/10.1118/1.1406519

The World Bank. (2017). PPP Reference guide (3rd ed.). Washington D.C.: The World Bank Group. https://doi.org/10.1002/tie.5060290205

Thompson, P., & Taylor, T. G. (1995). The capital-energy substitutability debate: A new look. The Review of Economics and Statistics, 77, 565–569.

UNEP. (2015). Energy Profile: Lesotho. Nairobi: United Nations.

United Nations. (2005). Rethinking the Role of National Development Banks. New York.

USAID. (2016). Power Africa in Madagascar, (September).

Vanheukelom, J., & Bertelsmann-Scott, T. (2016). The political economy of regional integration in Africa. Nairobi: European Centre for Development Policy Management (ECDPM). https://doi.org/10.1111/dech.12281

Waagsaether, K. (2014). An overview of the Energy Picture for SADC countries, with a focus on renewable energy. Cape Town. https://doi.org/10.2514/1.53301

Wahyuni, D. (2012). The research design maze: Understanding paradigms, cases, methods and methodologies.