Evaluation of Sustainability in Development Projects Utilizing
Renewable Energy Products in Zimbabwe

by

Barlas Demirciler

A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Science

Approved July 2014 by the
Graduate Supervisory Committee:

Mary Jane Parmentier, Chair
Gary Grossman
Arnold Maltz

ARIZONA STATE UNIVERSITY

August 2014
ABSTRACT

The problem concerning the access to energy has become an increasingly acute matter of concern in low-income areas. Currently an estimated 1.2 billion people don't have access to energy (IEA, 2014). Following the declaration of 2012 as "The International Year of Sustainable Energy for All" by the United Nations General Assembly (UNDP, 2014), this alarming situation of energy poverty has resulted in the creation of new partnerships between governments, NGOs (Non-Governmental Organization), and large multi-national corporations.

This study is focused on the evaluation of sustainability of a development project in Gutu, Zimbabwe that is initiated by Schneider Electric Corporation's BipBop Program. This program aims to provide access to energy via photo-voltaic cells and battery kits for daily use. It is expected that this project will have a high impact on sustainable development, and creation of value, which in turn is expected to allow participation in global supply chains.

The results gathered from the analysis show that the development project to be piloted in Gutu, Zimbabwe is likely to have a "high impact on sustainability". The project is therefore considered an effective sustainable development project that aims to promote, and develop local Zimbabwean markets through increased transactions and the creation of sustainable supply chains that are expected to recruit Zimbabwe into the global value chains.
ACKNOWLEDGEMENTS

This work is the result of a short trip to Zimbabwe in June, 2013 where I had the opportunity to volunteer as an engineer at SNV (Netherlands Development Organization) and participate in the initial studies and training sessions Schneider Electric held in Zimbabwe.

None of this would have been possible without the endless support and devotion of my family. I would like to extend my deepest gratitude to my parents, Kemal and Jale Demirciler, and to my brother, Teoman Demirciler.

I am sincerely thankful to my thesis committee, chaired by Mary Jane Parmentier, Ph.D. Dr. Parmentier’s encouragement and guidance throughout this work has been of great value. Additionally, I would like to acknowledge Gary Grossman, Ph.D. who has been such an inspiration throughout my graduate studies at Arizona State University. Lastly, but certainly not the least, I would like to recognize Arnold Maltz, Ph.D. for refining and enriching the ideas that are now the foundation of this study.

I would also like to express my thanks to Erik Boonstoppel from SNV, (Harare, Zimbabwe), and John Graham from Schneider Electric Corporation, (Grenoble, France).

Finally, I would like to devote this work to my late classmate and beloved friend, Antuan Erol Nofal, B.S.E.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF TABLES</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>v</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>LITERATURE REVIEW</td>
<td>11</td>
</tr>
<tr>
<td>METHODOLOGY</td>
<td>32</td>
</tr>
<tr>
<td>DATA ANALYSIS</td>
<td>50</td>
</tr>
<tr>
<td>CONCLUSION</td>
<td>59</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>65</td>
</tr>
<tr>
<td>APPENDIX</td>
<td></td>
</tr>
<tr>
<td>A TECHNICAL SPECIFICATIONS OF IN-DIYA PV LED KIT</td>
<td>71</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Sustainable Development Project - Evaluation Matrix</td>
<td>47</td>
</tr>
<tr>
<td>2. Impact Scale for Determining the Effect of the Project</td>
<td>49</td>
</tr>
<tr>
<td>3. The Assessment of the BipBop Project, Evaluation Matrix</td>
<td>54</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>World Map, Zimbabwe highlighted</td>
<td>12</td>
</tr>
<tr>
<td>2.</td>
<td>Sustainable Development, an Interdisciplinary Approach</td>
<td>37</td>
</tr>
<tr>
<td>3.</td>
<td>Project Life-Cycle Steps</td>
<td>40</td>
</tr>
<tr>
<td>4.</td>
<td>Modified Project Life-Cycle Stages</td>
<td>42</td>
</tr>
<tr>
<td>5.</td>
<td>Seven Districts of Masvingo Province, Gutu (in blue), 2006</td>
<td>51</td>
</tr>
<tr>
<td>7.</td>
<td>The In-Diya Photo-Voltaic (PV) Kit LED and Battery Kit</td>
<td>71</td>
</tr>
</tbody>
</table>
INTRODUCTION

Purpose of Study

The purpose of this study is to evaluate a development project with respect to sustainability and ascertain the impact it has on sustainable development. This interpretation is critical as the illustrated results enable a broader understanding of the outcomes. This study will target the case of a development project in Zimbabwe, initiated by a French based energy company, Schneider Electric, which aims to foster development within rural communities by providing access to energy that is harvested through a photo-voltaic kit, and stored in batteries. This initiative, under the company’s BipBop (Business, Innovation, and People at the Bottom of the Pyramid) program has extended its reach to Zimbabwe and “aims to promote access to reliable, affordable, and clean energy to the people who need it the most” (Desroches & Andre 2012). This work aims to provide a connection between development studies and sustainability literature that will enable a diverse approach for assessing existing studies.

Objectives

This work seeks to investigate the sustainability level of renewable-energy-related sustainable development projects. Consequently, it also encompasses the impact access to energy has on sustainable development, as well as rural Zimbabweans. This development project is geared towards providing access to energy in low-income areas in Sub-Saharan Africa, and has a vision of transforming rural Zimbabwean villages into independently
functioning local markets that will eventually interact with other markets around the globe through active participation in global value chains.

**The Problem**

The theory of sustainable development is widely accepted since its first definition in the Brundtland Report, which defines it as “meeting the needs of the present without compromising the ability of future generations to meet their needs.” (WCED, 1987). It consists of three pillars; sustainability is considered to include the social, environmental, and economic pillars.

The approaches for measuring sustainable development however, raise numerous questions as there isn’t a consensus, or guideline to follow for evaluating the environmental impact of an operational activity (Labuschagne and Brent, 2005). And although the economic pillar could be measured, and ascribed a value, via income levels, the social pillar creates further complications: “there is little agreement on which criteria should be considered for social performances [since] evaluations and methodologies are currently not practical for industry applications and business practices” (Labuschagne and Brent, 2005). This requires the development of a method that ensures a contribution to the efforts in sustainable development (Warhurst, 2002). An inclusive framework that assesses the sustainability level of a development project during the initial life cycle stages, is required to arrive at a definitive evaluation of the impact on sustainable development of such projects (Labuschagne and Brent, 2005).
Therefore, this work is focused on the problem of measuring the impact on sustainable development of a development project during its initial stage. Furthermore, this work seeks to examine the impact of Schneider Electric’s initiative and the effect it has on empowering rural Zimbabweans. This study also incorporates the impact the project has on the creation of value, which will enable the inclusion of developing countries and open their horizons to international markets. The set of objectives will be accomplished by analyzing the results obtained from an evaluation matrix, assessing the sustainability factors with respect to the phase of the development project. The analysis will be based on my experience as a volunteer in Zimbabwe where I had the opportunity to be directly involved in the training for Schneider Electric’s Photovoltaic-kits.

Significance of Access to Energy

Access to safe and reliable energy is described as a key ingredient for development; it virtually supports all the components of human survival, and is labeled as a critical enabler for social and economic growth. (Brew-Hammond & Crole-Rees, 2004). Moreover, the issue surrounding energy poverty is also considered a major concern for sustainable development (Ailawadi & Bhattacharyya, 2006).

In developing countries, securing access to reliable energy services is a crucial step to ensure economic prosperity and improve health conditions. “This is because it is essential for the provision of clean water, sanitation and healthcare, and provides great benefits to development through the provision of reliable and efficient lighting, heating, cooking, mechanical power, transport and telecommunication services” (Olejarnik,
In essence, access to energy enhances the life of the poor through the aforementioned services. This enhancement is possible by; the extension of working hours through lighting, operation of electrical equipment for refrigeration, and irrigation. More importantly, access to reliable energy can directly impact the alleviation of poverty through value creation and trade (Pereira, Freitas, & da Silva, 2010).

Background

It is particularly challenging to coin a definition for development, but it has generally been accepted to be a progression towards improvement, and shifts a nation to a more desirable state. In the early 1900s the favorable path to a developed state was often considered to be purely of economic development, reflecting a nation’s industrial output and export volumes. This highly robust movement neglected basic environmental factors. Pollution was one of the most serious problems encountered throughout the industrial years of the European continent, where many have accounted the severity of the air quality. In Great Britain’s case: “London’s sky would surrender to an ominous layer of smog which would settle for days and cost the lives of hundreds.” (Bell, Davis & Fletcher, 2004).

This new trend in automated mass-manufacturing, initiated with the industrial revolution, was fueled by aggressive desire for economic growth and prosperity. However, a key point, and an essential ingredient for such a destined productive future can only be achieved if the development model can be applicable in the future as well; a
development model that ensures the socio-ecological and socio-economic continuity of the Earth.

This revolutionary period, triggering the consolidation of a fundamentally capitalistic structure, followed by the development of modern sciences, disregarded the consequences of the industrial revolution movement (Hopwood, Meller, & O’Brein, 2005). After all, the objectified economic growth was accepted as an increase in production capacity and rising yields (Douthwaite, 1992). In turn, it was assumed that this model would transform the life of the poor, as society would be raised to the next level (Hopwood et al., 2005). Although the idea was essentially flawed and utopic in its nature, it gives a better understanding of the ideology of that period which fueled the rise of industrialism, and the completely unmindful state to the unintended consequences of pollution.

Toxic plumes rising from industrial towers greatly altered the ecological cycle, and its effects are still present: An article assessing the volumes of Carbon emissions from 1751 (beginning of industrial revolution) to 1949 (height of industrialization in Europe and the U.S) show an increase from approximately 3 million to 61 billion metric tons of carbon. This is roughly equivalent to a staggering 600 million per cent change. (Anders et al., 1999). Studies, like that of Anders et al. (1999), have evoked broader questions and highlighted the importance of sustainable development. This growing concern regarding the environment and the natural habitats, have been a major eye-opener for other experts and academicians.
The term “Sustainable Development” made its first public appearance in the Brundtland Report published in 1987 where it was defined as “meeting the needs of the present without compromising the ability of future generations to meet their needs.” (WCED, 1987). Since then, the notion of sustainable development has been open to debate and an exact definition has been subject to much speculation. Its popularity today can also be attributed directly to the “…growing awareness of the global links between mounting environmental problems, socio-economic issues to do with poverty and inequality and concerns about a healthy future for humanity. It strongly links environmental and socio-economic issues.” (Hoopwood et al., 2005).

The Brundtland Report clearly emphasizes the importance of the ecological sphere and makes recommendations on the interaction of socio-ecological and socio-economic issues for future practices. “This report led directly to the term ‘sustainable development’ passing into policy discourse, if not into everyday language.” (Redclift, 2005). Redclift (2005) highlights that the Brundtland Report was the first written document to link the socio-economic and socio-political aspects of development from an environmental perspective. Hopwood et al. on the other hand, stress the vitality of the environment and claim that the present and the future all mankind depend on the continuity of the ecological system for security and basic needs (Hoopwood et al., 2005).

Furthermore, the Brundtland Report mentions the issue of attending to the global problem on poverty, protecting the ecological systems and achieving economic growth. Hopwood et al (2005) state that the looseness of the concept and its theoretical underpinnings have enabled the use of the phrases such as “Sustainable Development”
and “Sustainability” to become *de rigueur* for politicians and business leaders. This underlying gap in the vague definition paves the way for businesses and governments to ever expand, whilst justifying their efforts as a support for “Sustainable Growth.” Dollar and Kraay (2002) for example, argue that economic growth will eradicate poverty similar to Douthwaite’s (1992) assessment of growth during the industrial revolution.

It is common to say that the “Sustainable Development” path is a necessary policy for nations to ensure the permanence of the planet, however there is a fundamental aspect and an important backbone that seems to be missing in the broad definition. And that is a mutually agreeable definition to the terms; “Sustainable Development”, and “Sustainable Growth” from all angles of disciplines. Daly (1993) famously criticized the term “Sustainable Growth” as an oxymoronic idea in a setting where all ecosystems are finite. According to Daly, the definition of “Sustainable Development” lies with more qualitative justifications and advancements rather than quantitative ones like the Brundtland Report suggests.

In essence, adding the term “Sustainability” in front of “Development” made it almost impossible to announce a coined definition. For the purpose of clarification, this study uses the phrase “Sustainable Development” to describe a developmental model that seeks to mitigate the harmful effects of development on society and the environment, whilst aiming to mitigate poverty. This leads to the question: How can underdeveloped nations even afford, let alone transition, to a path of “Sustainable Development”?

The classic literature shows that there are quite a number of different ideas on growth and much of the material has been written on, or relating to development theory;
economic growth models like the Harrod-Domar Model that relate the level of savings and the capital output ratio of a nation, theories such as the modernization theory that attempt to explain the modernization phenomenon and how economic prosperity can be achieved, and other philosophical works linking development as a means for freedom (Sen, 1999).

Perhaps the last two, modernization theory and human development are the most controversial and conflicting theories, especially in the case of Sub-Saharan Africa (SSA), a region, consisting of relatively young African nations that have severely been exploited through colonial powers in the past, and are currently implementing effective growth models while battling epidemics, famines, violence, migration, and political inequalities (Ranger, 2004). Such is the case of Zimbabwe, a relatively young nation located on the southern region of Africa. Experiencing a very similar history to the aforementioned fate of SSA, Zimbabwe is struggling with many problems that oppose and greatly risk the future generations of the nation. Currently one of the poorest nations in the world, with a GDP per capita of $837 and an HDI rank of 173 (World Bank, 2012), Zimbabwe is primarily supported by aid and greatly lacks in infrastructure and development despite the mineral and underground wealth. This places Zimbabwe at a focal point for developmental initiatives.

However, the most important impediment to development in Zimbabwe, in addition to those mentioned already, is the problem of access to energy. Although not a shortcut to prosperity and growth, energy is a necessary instrument that has to be utilized. Virtually all tasks carried out in manufacturing use electrical automation; it is almost
impossible to conceive a production line that doesn’t require energy. As much as its importance in the industrial segment, access to energy is also a crucial indicator of a region’s energy poverty. Just like the dependency in automated manufacturing, energy is also indispensable when it comes to domestic use; endless tasks that range from lighting to refrigerating that greatly impact quality of life.

Promoting access to energy has become an increasingly acute matter of concern for governments and NGOs in low-income areas. Currently an estimated 1.2 billion people don’t have access to energy (IEA, 2014). The United Nations General Assembly, recognizing these alarming situations in global access to energy, declared 2012 The International Year of Sustainable Energy for All (UNDP, 2014).

A decade ago, the rate of access to electricity in region of SSA was 17% which is noted to be the worst and lowest rate in the world, however, a worse picture is drawn for rural areas as the rate drops down to a staggering 5% (Davidson & Mwakasonda, 2004). This alarming rate of access to energy, extreme poverty, epidemics, and various other developmental concerns has attracted many international NGOs to take action in Zimbabwe. This network of NGOs and NPOs have aided in numerous humanitarian projects and in June, 2013 have established a partnership with Schneider Electric aimed to eradicate the problem of access to energy. Recruiting the French based energy management giant with a market cap of $ 42.16 Billion across the globe, Schneider Electric joined forces with SNV - Zimbabwe (Netherlands Development Organization), Practical Action - Zimbabwe (A UK based development charity), Oxfam - Zimbabwe (Another UK based international organization) and Samansco (A Zimbabwe based
Renewable Energy Company) to aid in the development efforts taken by the Zimbabwean government and NGOs.

In order to assess the effectiveness of the BipBop Program in Zimbabwe, and understand how it contributes to sustainable development, the three pillars of sustainability (economic, environmental, and social) have to be measured and analyzed according to the project stage. This requirement calls for an evaluation matrix that will enable the assessment of each of the three pillars. The results will then help in evaluating how effective the BipBop Program in Zimbabwe is.

This work also seeks to ascertain how Zimbabwe can develop utilizing the BipBop Program’s sustainable development project. What is the significance of access to energy in low-income areas? How can nations like Zimbabwe prosper without the drastic effects of industrialization? Or is sustainable development a feasible path? How does sustainable development link with global value chains? And finally, can a multi-national energy-management company accomplish something that has been subject to much speculation and public scrutiny? Can Schneider Electric Corporation lay the corner stones of a practicable sustainable development agenda for Zimbabwe, and aid in current development initiatives carried out by both foreign, and local development agencies aimed at fostering economic growth with the creation of value? How can Zimbabwe utilize its resources and exploit them to its full potential whilst empowering the unemployed, and buy into the global value chains? Can Zimbabwe utilize this program and utilize the power of automation to create value and shift its place in the world. These are some of the questions this paper will attempt to answer.
LITERATURE REVIEW

*Historical Overview of Zimbabwe*

South of the Sub-Saharan Region of Africa, lies the “Jewel of Africa” as coined by Leander Starr Jameson in the late 19th century, one of the first British colonizers along with Cecil John Rhodes as they took a short trip over the Zambezi River to discover the beauty and resources the nature had to offer. Unfortunately today, one would have a hard time describing Zimbabwe using the same expressions. The colonial period, extraction of its natural resources, mass migrations, violence, and much bloodshed has left the state with nothing more than a weak economy and an unstable democracy.

It was in 1889 when the British South Africa Company, chartered by Queen Victoria of the United Kingdom first gained control of what is Zimbabwe today. Under the leadership of Cecil Rhodes and the power constituted by the charter, trained armed forces of the company, the Pioneer Column, marched north to acquire and control Mashonaland, which is home to largest ethnic group in Zimbabwe today, the Shona. Rhodes was eager and determined to gain full control of the region and engaged in several conflicts with the Ndebele and the Shona Tribes. After several battles in various scales, within the Matabeleland and Mashonaland, the Pioneer Column (British forces raised by Rhodes) decisively defeated the indigenous armies of the Ndebele and Shona and established their authority within the Region (Ranger, 2004). After their victory, the Company controlled the lands that now make up Zambia and Zimbabwe. This newly acquired territory, under the British and led by Rhodes, was called the Chartered territory
of the British South Africa Company until creation of The Federation of Rhodesia and Nyasaland, also referred to as the Central African Federation, which was a semi-independent state in southern Africa from 1953 to the end of 1963. Following the split of Northern and Southern Rhodesia, as Zambia and Zimbabwe respectively in present time, Southern Rhodesia was simply known as the Republic of Rhodesia until 1979 led by Premier, Ian Smith. A transitionary reconstitution, which created the state of Zimbabwe-Rhodesia led by the majority rule, finally laid the path for the Republic of Zimbabwe that was recognized as of April 18, 1980.

Figure 1. World Map, Zimbabwe highlighted.
Since independence, Zimbabwe has experienced continued violence and political tension and turmoil. The controversial issue of land-reforms has attracted much attention by the global press, where massive quantities of farm lands, which mainly belonged to White Zimbabweans, have been seized violently and handed over to the politically empowered or the internally connected (Richardson, 2004). Following these incidents, the stagnant but instable economy virtually went downhill. Also fueled by other factors, such as unemployment and fraudulent government spending (Games, 2010), the Zimbabwean currency horrifically experienced hyper-inflation and resulted in the replacement of the currency with the U.S Dollar in late 2009. This imbalance drastically hit the poor and made matters worse. Zimbabwe was now one of the poorest nations in the world with a GDP per capita of $837 and an HDI rank of 173 (World Bank, 2012) and is majorly supported by aid.

*Foreign Aid & Attempts for Growth*

Presently, despite the aid that have been given to the region of SSA so far, Zimbabwe is still struggling to advance as a society and develop a healthy, stable economy. There are two scholars that have particularly focused on the issue of aid to the region: Jeffrey Sachs and William Easterly. An intermediate perspective to the ever-battling views of Sachs and Easterly of “Planners” versus “Searchers,” in the context of economic development in Africa, is proposed by Paul Collier. Like Sachs, Collier believes the western foreign aid and technical assistance with infrastructure is an important means to mitigate poverty in low-income and poor regions. However, like
Easterly, he questions the usefulness of foreign aid, and stresses the importance of proper accounting and monitoring of funds. Explicitly denoting both of these stances, Collier dismisses what Sachs calls optimism regarding the financial aid, and the skepticism of Easterly regarding external contributions of searchers. He further continues his analysis into different sections where one is focused specifically on “traps”.

One trap Collier describes is bad governance. Although there are varying accounts that policies placed by the government have a substantial effect on growth, there are surely other vital dynamics that are greatly affected and eventually altered by poor governance; corruption undermines markets, institutions and most importantly: public trust. These all weaken social structure and civil society (Collier & Goderis, 2009). Furthermore they can cause a fragile setting for a government that is bound to fail to provide security for its people and ensure development of the nation. This trap Collier describes perfectly relates to the case of Zimbabwe where corruption levels have steadily increased. Many developmental projects and foreign aid have been misplaced or ended up in offshore accounts (Makumbe, 1994). Furthermore, many of the laws and reforms that have taken place since independence have been heavily scrutinized and referred to as controversial by many authorities (Games, 2010). One of these restructurings in the constitution is Zimbabwe's notoriously known land reform policy that has steadily paved the way for shortage of agricultural produce (Richardson, 2013 & Games, 2010).

Another important deficiency in the case of Zimbabwe is the shortage of electrical energy. In the politically corrupt and bankrupt nation many rural towns and villages are not connected to the national electric grid due to limitations in infrastructure and
available funding. According to the information obtained from the CIA (Central Intelligence Agency) Database regarding the electricity production in Zimbabwe, Zimbabwean Electricity Supply Authority (ZESA) - the official state-owned utility company that is responsible for the production and distribution of electricity - the nation produced an estimated 7.81 billion kWh in 2010 while the demand was approximately at 12.57 billion kWh (CIA, 2014). This inability to meet the demand results in persistent outages that greatly hinders the ability for automated mass manufacturing and thus greatly hinders the creation of value.

Zimbabwe and Schneider Electric

Schneider Electric is one of the few utility companies that have shown considerable interest in aiding in developing the underdeveloped world. Aiding, not in the conventional sense of financial arrangement; loans, or grants, but, aid in the sense of mentoring, teaching, and improving the growth of knowledge that is aimed at spurring a market that is able to sustain and self-perpetuate upon careful guidance and initiation.

The African continent, considered the youngest and the fastest growing continent in recent times, is developing economically: During the “Africa in the World Economy” panel in 2012 Donald Kaberuka, the President of the African Development Bank, has stated that Africa has had an excellent decade in terms of economic growth and poverty reduction, which he also considers to be the best in fifty years (Brede, 2012). However, Kaberuka argues that one should not confuse economic growth with economic transformation. He further states that the structures of Africa’s economies are not
evolving in an adequate sense and the continent is still commodity dependent and thus vulnerable to external shocks in global economy (Brende, 2012).

Presently, some of Zimbabwe’s biggest concerns are the problems and challenges rural towns and villages are facing. Many Zimbabwean communities that are bordering the neighboring countries have no access to electricity. The Gutu District, lying on the southern skirts of Zimbabwe, is a small district comprising of just 198,000 in 2002 (Hamandawana, Nkambwe, Chanda, & Eckardt, 2005). Due to the lack of infrastructure and power, schools, clinics and hospitals operate on a shoestring budget. Without any other option, most of these funds are allocated to candles and lanterns. Children are forced to study with candlelight, while women going into labor are forced to give birth using the light from cell phone screens. In a state of despair, members of these communities are awaiting a change.

In response to this despair, the Zimbabwean government founded the Rural Electrification Fund (REF) in 2002. This was the initial step in devising solutions for these villages. This, in turn led to the creation of the Rural Electrification Agency (REA), whose mission was to extend the electric grid to villages and towns that are in need (Mapako & Prasad, 2007).

The Zimbabwean government recognizes the fact that rural electrification is a major pillar in improving socio-economic development in communities. In this aspect, the Rural Electrification Agency has accomplished more than 5000 rural projects that are comprised of institutions, farms, villages, boreholes, dam points and irrigation schemes electrified to date (Mapako & Prasad, 2007).
However, in a rapidly growing society and an emerging market like Africa, Zimbabwe must ascertain swifter solutions that are both: effective and sustainable. Extending the electrical grid to areas of high impact, such as irrigation schemes, schools, hospitals and clinics is absolutely necessary. Nonetheless, the costs determined for such projects are considerably high without any control over development (Mapako & Prasad, 2007).

Schneider Electric’s BipBop program - “which aims to promote access to reliable, affordable, and clean energy to the people who need it the most.” (Desroches & Andre 2012) - Recently extended its vision over to Zimbabwe in the summer of 2013. Schneider Electric, a French giant in the energy industry, has plenty of experience developing and implementing this project. They have launched these projects in South America, Asia, and some countries in Western Africa. Schneider Electric aims to provide sustainable solutions via photovoltaic cells, attached to a battery charging kit, batteries and an LED lamp. This operation is initiated by Schneider Electric, but run by local community members that are the entrepreneurs that start their businesses of renting batteries and LED (Light Emitting Diode) lamps. This cycle will in turn create businesses within local communities and spur a self-sustaining market (Desroches & Andre 2012).

Though there are no initial figures that reflect the performance in Zimbabwe, Schneider has been quite successful with its BipBop project in other remote parts of the world like India, and Peru. A similar projection is made for Zimbabwe: Following is an excerpt of the paper by Desroches and Andre (2012) that shows the economic success of the BipBop program implemented in India:
As of end of March 2012, 57 entrepreneurs created their business of lighting system distribution and battery rental. Their average revenue is 2,500 to 3,000 INR (35 to 43 €) per month. Each entrepreneur has an average of 9 customers, thus reaching up to 530 people who now have access to highly energy-efficient lighting systems. (Desroches & Andre, 2012)

Schneider’s initiative in the area will undoubtedly aid in efforts put forward by current NGOs and development agencies, and other important actors in the major intervention efforts. According to the research by Desroches & Andre (2012), providing a quick and easy solution like this will positively impact the communities. An important question to ask is: How this project will impact the growth of local entrepreneurs in Zimbabwe? It is expected that a technologically aware generation will arise, that will aid in their own communities’ efforts.

Desroches and Andre’s study (2012) utilizes the “Sustainable Livelihoods” framework and places a strong emphasis to assess the impact access to energy has to the poor in rural villages and towns in India. Initially, it is expected that this access will directly lead to extended hours of operations at community centers, markets, and clinics. During the project cycle, the extended store hours led to a rise in transactions and high rate of exchange in the marketplace. According to the study and literature review conducted by Desroches and Andre (2012), this trend will result in an economic cycle that will gradually attract local entrepreneurs that will create their own products, thus
creating a value stream network and a value chain that Porter defines as a key element for competitive strategy (Porter, 2000).

Creating such a chain is invaluable to low-income nations. In order to promote economic prosperity, it is equally crucial to export the manufactures and products to other countries. It is only through the utilization of international trade that low-income countries like Zimbabwe will receive recognition and attract large corporations for certain businesses and increase export figures. For the case of Zimbabwe, this could be made possible through the “Global Value Chains” (GVC) where larger multi-national corporations shift a portion of their manufacturing processes to low-income areas to benefit from low production costs, and in turn have a positive impact on development.

*The Global Value Chains*

It is important to scrutinize the global value chain. Developing nations that support their economies by international trade cannot perform to their fullest potential, mainly due to the lack of infrastructure, and poor marketing decisions. These countries, often unable to achieve strategically favorable market positions, enter certain areas as suppliers for giant companies or conglomerates. This outsourcing of manufacturing creates a value that flows to the other spectrum of consumers i.e. the developing world. It is through this flow that developing countries can participate in a global trend that otherwise would be unavailable. From a macro perspective, it seems economically beneficial for both the suppliers (developing nations) and the buyers (the developed
nations). GVC research concentrates on understanding the interactions of these business transactions and their potential impacts on development.

Humphrey and Schmitz (2008) analyze the impact of governance in global value chains in their study and prove that the global value chain has a direct effect on developing economies. They portray the example of a UK company, Tesco’s, influence on the production of mange tout (snap pea) in Zimbabwe. Tesco had immense influence in operations thus taking the fate of an underdeveloped country in their hands. Humphrey and Schmitz (2008) then go on explaining the importance of governance in a GVC.

There are a number of issues and complications that arise in an international global value chain. Trading barriers and related complications are some of the usual difficulties underdeveloped countries face with exporting. Developed countries may clear trading barriers, but it is ultimately up to the lead firms or buyers in that chain that determine the fate of the trade. This uncertainty is overcome by the domination of the lead firm’s demands and requests, as was the case in Zimbabwe with the British Tesco.

Buyers specify requirements to suppliers to alleviate the gap in quality and since the specifications of the supplier’s market are inferior to the large-scale, advanced market of the developed world, companies that impose such requirements are referred to as “lead” in GVCs. Other concerns for the lead firms are the conditions of the manufacturing and production capabilities in the developing world. The authors assert that specifications in quality and efficiency are direct factors that play a role in transformation of developing countries into mass-manufacturing hubs. The authors cite the examples Brazil and Vietnam that underwent such a change and are now major export
manufacturers in the clothing and apparel industry. Humphrey and Schmitz (2008) emphasize the importance of guidance and high demands set by the lead firms: “It is [this] combination of high challenge and high support that is often found in the highly governed chains and that explains how relatively underdeveloped regions become major export producers in a short period of time” (Humphrey and Schmitz, 2008).

However, it is also stated that the tangible side of the spectrum in manufacturing does reap low profits and gains, while the intangible; often times involving the research and design, and marketing segments demand high credentials for entry and a solid position in the market. The authors raise the question of whether or not a fair gain is attainable with such a distribution system. Another point that is made on the importance of governance in GVC is the volume of activity that has attracted governments. They hold a strong position in governance and play an important role in raising ethical trade standards. They further add by stating that the global chain governance is the foundation for the ethical trade initiative the UK government initiated.

Governance of GVC also ties to development. Humphrey and Schmitz label the link as a “funnel for technical assistance.” Contrary to the direct foreign investment form of aid, this connection provides the more tangible form of support, offering technical assistance.

Multilateral and bilateral donor agencies have for decades sought to find ways of providing effective technical assistance to developing-country producers. Progress was at best modest. Recently these agencies have
embarked on experiments of fostering TNC [Transnational Corporation] – SME [Small and Medium Enterprise] partnerships. The central idea is to combine technical assistance with connectivity. (Humphrey and Schmitz, 2008).

**GVC, Zimbabwe, and Sustainability**

With the case of Zimbabwe and the BipBop Program, Zimbabwe is projected to participate in the GVCs initially through small-scale value added products. These products can range from apparel to simple household utensils that are produced utilizing the energy harnessed through the PV kits. These sustainable goods, produced using renewable energy, can then be exported to various locations and help raise the average income in Zimbabwe, and positively impact sustainable development. Orchestration of such a value chain is proposed to begin with a lead firm reaching out to small and medium sized suppliers in the developing world and mentoring them to attain firm positions in the GVCs. With its sustainable production capabilities, Zimbabwe can attain a strong position as a candidate for supplying certain goods and products across the globe.

It is also recognized however, that the fierce competition will require rigorous efforts to retain their positions. Ultimately, the suppliers are controlled by the buyers and the hegemony within the chain is quite apparent. Such efforts to retain supplier positions are applied through audits and have rigid criteria and harsh consequences that may terminate future business relationships.
This leads to a troublesome interaction between the suppliers in the developing world and the buyers, (the lead firms) in the GVC. Quality assurance is the principal risk lead firms are concerned about. Humphrey and Schmitz (2008) argue that the quality conformance may shift to a third party agent, outside the chain, thus making the chain in less need of governance. Such an effort may be consolidated by development agencies to aid in the infrastructure and technical assistance they already promote. The authors conclude by acknowledging the success of recent producers that have conformed to the buyer’s specifications and show a more promising future for forthcoming business opportunities and forming manufacturing clusters. Thus it is possible to make a similar projection for the case of Zimbabwe, given that the sustainable development initiatives through Schneider’s BipBop Program succeeds.

Besides the high quality standards and foreign procedures manufacturers are supposed to adhere to, there are other complications that arise in low-income countries that desire to participate in GVCs with hopes of economic and social prosperity. Further studies are conducted analyzing the role of low-income countries in GVCs. There are other various factors that affect the performance in these countries, which may result in dire consequences like, contract termination. This may, or may not be the case for Zimbabwe as a low-income country in SSA, but certainly an important item to consider for future plans.
Opportunities for smallholders from developing countries in GVC

The study conducted by Lutz (2012) points at the importance of Zimbabwe as a developing country in global value chains. Whether it is for agricultural markets or light industries, the aim is to showcase the vitality of supply chains and the impact it’s going to have on Zimbabwe’s economy. Furthermore, it may create new opportunities for employment and strengthen Zimbabwe’s position in the global value chains.

Lutz (2012) takes on the notion of “trading out of poverty” and assesses how it relates to Africa, and its potential conflicts. The leading point that assures the cohesiveness of the idea is the self-sustaining market. It has been mentioned that in order to stimulate such a market, they ought to be functioning properly and far from corruption and severe government interference. This is supported by the work of (Hayes, 2006) where competitive equilibrium theory is used to show that welfare, and thus socioeconomic development, can be improved through trade.

“Several NGOs stress the importance of fair trade as an instrument to replace competitive forces and to provide better opportunities for producers in developing countries” (Lutz, 2012). Lutz uses the definition of GVC as “the full range of activities which are required to bring a product or service from conception through intermediate phases of production, delivery to final consumers and final disposal after use.” (Lutz, 2012). In other words, GVCs allude to the creation of wealth, along with value. The literature sited by Lutz suggests a growing interest in the integration of GVC and developing countries, mainly on the opportunities for producers in the developing world.
With the creation of value and wealth, comes competition. A crucial ingredient for this the undertaking of this grand scheme is the continuity and the most critical stage is its survival within the initial stages of implementation. Although Lutz (2012) mentions the importance of institutions and government, he fails to address the vitality of government, NGO, and corporate partnerships. Such collaborations yielded fruitful results in remote parts of the world with similar social and economic disparity like India (Desroches & Andre, 2012). The absence of proper guidance and coalitions will not achieve the objectives and fail far sooner than reaching the goals of sustainable development. Developing countries and low-income countries should make full use of such partnerships to build small, yet effective value chains, which will eventually lead to small industries capable of supplying products and manufactures to the lead corporations in the GVCs.

There is strong evidence in development and supply chain literature that connect the strength of a nation’s supply chain, or GVC, and its performance in [sustainable] development. It is rather the volume of net activity in the supply chain that contributes to the overall developmental initiatives in a nation. There are further evidences that link the supply chain strength to sustainable development. In the midst of all of these activities, the value chain, or, supply chain, and the growing industries should adhere and stay committed to sustainable development agendas. Studies have shown that the strength within the supply chain is directly related to sustainable development.
Supply Chain Strength and Sustainable Development

Vachon and Mao have taken a wider scope in analyzing the connection between supply chain strength and sustainable development. Their analysis, motivated by the criticism global corporations have been receiving by varying lobbying groups, investigates the relation between the aspects pertaining to supply chains and the three sides to sustainable development that have defined as “environmental performance, corporate environmental practices and social sustainability.” According the statistical analysis conducted by the researchers, the strength of a supply chain is “positively linked to all the three dimensions of sustainable development” (Vachon & Mao, 2008).

According to Vachon and Mao, corporations are required to include the social dimensions of sustainability practices throughout their tasks and operations. This also affects the distribution of wealth, thus signaling a revision in the conventional supply chains to better aid in the cause for sustainable development. The key contribution the paper has made is the adoption of a broader lens for analyzing a company’s environmental performance. Instead of analyzing a single manufacturing plants environmental score individually, Vachon and Mao scrutinize the upstream and downstream in the production processes, and thus create a macro level analysis of a country’s supply chain strength and linking the results to the aforementioned three dimensions of sustainable development. This is clearly underlined in their literature review, which points out that issues such as labor practices gender, equity, wealth distribution, and fair wages have been seldom addressed in supply chain literature.
Additionally, Vachon and Mao also mention the vast number of terminologies specifically used to describe the relations in the upstream and downstream operations within supply chain. This is a similar problem encountered in sustainability research, stemming from multiple definitions given to the word “sustainability”. The problem with definition Vachon and Mao claim is not directly related to sustainability per say, but due to the void in the definition of a macro-level supply chain. The example they use is a location problem of a manufacturing plant, which is ultimately designated to be constructed at a location for the sake of proximity to its suppliers. Vachon and Mao highlight the deficiency in linking the industrious factions to a nation’s sustainable development efforts (Vachon & Mao, 2008).

Overall, this interdisciplinary framework, can aid in examining the development trends of underdeveloped countries that are striving to adopt the notion of “trading out of poverty”. Adopting such a framework places a strong emphasis on value creation and global value chains. Multi-faceted approaches like these will bolster support for other inter-disciplinary research and create further research opportunities for practitioners and academicians.

Vachon and Mao claim to hypothetically link supply chain and environmental management (Vachon & Mao, 2008). What is to be further studied is the new field. Does this association mean a new horizon for future academic research? Can it serve as an agenda for developing and low-income countries?
To decipher these terms and disciplines, a closer look into the definition of supply chains has to be referenced and scrutinized. Handfield and Nichols, provide a definition for Supply Chain in their textbook (1999).

The supply chain (SC) encompasses all activities associated with the flow and transformation of goods from the raw materials stage (extraction), through to the end user, as well as the associated information flows. Materials and information flow both up and down the supply chain…SCM is the integration of these activities, through improved supply chain relationships, to achieve a sustainable competitive advantage. (Handfield and Nichols, 1999)

Although complete in providing the definition that covers business principles, it fails to address the notion of sustainability. For this matter, this portion of the literature review is going to focus on the definition of sustainable supply chains in an effort to furnish stronger understanding of the terms and definitions.

Sustainable Supply Chains

As a part of the ever growing network of a society the world has transformed into, manufacturing and production processes are dispersed around the globe to bolster higher profits. This race towards acquiring the lowest production rates are now greatly challenged by growing environmental concerns. Focal companies or leads, that are
defined as those that rule and govern the supply chain, as well as being responsible for the final delivery to the customer are under critical scrutiny by NGOs. Many sought after brands such as Adidas, Nike, and Levi Strauss have been accused for environmental and social problems that have occurred during their production phases.

In their paper, Seuring and Muller (2008) present a literature review on the subject of sustainable supply chain management as well as a conceptual framework. Their work shows that only eight papers, published from 1994 to 2007, have offered a literature background on the matter. They further their study by summarizing the highlights of the literature they have conducted reviews on, and highlight their focuses on supply chains.

It is crucial to include literature from a variety of subjects for analyzing sustainable supply chains. Since the issues surrounding sustainable supply chains are no doubt an inter-disciplinary research area, it requires multi-faceted approaches and ideas from both social and environmental context. It is only after a successful and adequate mixture of those two disciplines, that any work on sustainable supply chains will prove worthy.

Carter and Rogers (2008) also present a conceptual framework that aims to integrate the understanding of sustainability within the world of supply chain management. Upon their literature review, they have arrived at the conclusion that the term sustainability has been defined and used inconsistently. This shows the problem arising from the absence of a mutually agreeable definition of a term that is at its peak of exposure in business and academia.
In an environmentally conscious society today, supply chains are at a crucial point as they can immensely affect the sustainability practices. These can range from transportation to packaging to warehouse conditions (Carter and Rogers, 2008).

Concluding Remarks

The literature that has been reviewed for the purpose of this study was aimed at furnishing details about the poverty, lack of infrastructure, and the problem of access to energy in Zimbabwe from a historical perspective. The dire effects of colonialism, and the political instability that has followed are some of the essential reasons on the present situation Zimbabwe is in. Previous development projects, mainly in the form of foreign financial aid, were also mentioned to give a clearer picture of the effectiveness and end results. These attempts for development were not proved effective and have been considered a failure in reaching their stated goals. According to the literature the physical form of aid, in terms of aid in technical issues and infrastructure were proven to be more useful.

Furthermore, an introduction of global value chains, and sustainable supply chains were provided to attain a clearer understanding of the concepts and how they relate to development studies. The aim of the literature review was to identify and elaborate on the gap between sustainable development and sustainable supply chains and to build on the existing theories. This expansion will result in a cohesive framework to understand the significance of the creation of value and how it can be utilized in the context of
sustainable development. The study will build on this framework and further explore possibilities for future research.
METHODOLOGY

The methodology followed in this study is derived from the need to analyze and quantify the impact on sustainable development of a development projects in Zimbabwe. A framework, designed to be inclusive and informative to researchers and development workers, is generated to aid practitioners and researchers to better assess the feasibility of sustainable development projects. This framework shall be designed in a matrix to ensure maximum reliability and ensure for the consideration of the selected factors that make up the dimensions. These two matrix dimensions will represent (1) the three pillars of sustainability, and (2) the project life-cycle. This classification is necessary to pinpoint and clearly understand the performance of each item that, in a whole, represents the pillars that define sustainable development.

The results gathered from the matrix will aid practitioners and researchers in understanding the effectiveness of the project. Moreover, since the evaluation matrix utilizes a project life-cycle stage as a dimension, parts of the project that need improvement and revisions will clearly be visible according to the project’s phase. The findings from the matrix will then indicate the potential effect the project has on sustainable development. A result that yields a “high impact” on sustainable development indicates that the project is likely to have a positive impact on the three pillars of sustainability and lay the foundation for a self-perpetuating sustainable market that will create value, and participate in GVCs across the globe. This cycle is expected to result in economic, social, and environmental improvements in Zimbabwe with the rise in average income, the creation of jobs, and production low carbon footprint products.
Fundamentally motivated by the “Sustainable Project Life Cycle Management: the need to integrate life cycles in the manufacturing sector” paper (Labuschagne and Brent, 2005), this study shall serve as an alternative source that is more inclusive and particularly concentrated on attaining results for the preliminary stage of a sustainable development project. The breadth of the scope will enable the incorporation of areas that were previously not accounted for by various methods such as the Life Cycle Assessment (LCA).

Previously published sustainability methodologies and frameworks were sought to be utilized for this study, however they have been found to be limited in terms of scope and output in the context of development projects. Such frameworks, such as LCA, do not pay close attention to the crucial points of social, and political context of development projects, and are heavily oriented towards data-analysis. This requirement of data makes it impractical for development workers, and certainly impossible to assess the sustainability of certain projects prior to implementation. Vast majority of the projects carried out in SSA are heavily geared towards sustainable development, supporting the MDG (Millennium Development Goals) agenda, and directly aimed at impacting the three pillars of sustainability (Social Inclusion, Environmental Sustainability, and Economic Development). Since the aim of the BipBop Program is to adhere to the ideology of sustainable development, a method is needed to assess the projects with accordance to the sustainability level. Such a framework must incorporate diverse factors and be able to translate the qualitative data into qualitative data for practical use. This framework for assessment ought to be consistent and efficient for a vast array of
development projects waiting to be implemented. These requirements conform to the development of an evaluation matrix within the sustainability and life-cycle framework, utilizing the two factors as the matrix dimensions.

“Aligning project management methodologies with the principles of sustainable development requires a comprehensive sustainability evaluation to assess projects in terms of sustainability consequences” (Labuschagne and Brent, 2005). Building on this central theme, the developed Evaluation Matrix by Labuschagne and Brent (2005) is applied to this study with a purpose to offer an alternative method of analysis for renewable energy related projects. The matrix offers an evaluation that is critically poised at analyzing the sustainability levels and impact on sustainable development of a project in any given stage of the life cycle. The purpose of this chapter is to provide a detailed explanation of the life-cycle sustainability assessment, and employ the methodology to evaluate Schneider Electric’s initiative in Gutu District, Zimbabwe.

In essence, this study will utilize a similar form of the matrix evaluation tool that has been previously implemented by McConville (2006) and Chow (2010). Their studies have concentrated on issues directly related to development projects, and have been used exclusively for the purpose of evaluating projects with respect to different variables. McConville’s (2006) work concentrates on the issue of water sanitation in Mali, West Africa. In this study, an evaluation matrix is used to assess the impact a water sanitation project had on the community and other pillars of sustainable development. Chow (2010) on the other hand focused on the impact the use of solar home systems on an archipelago in Vanuatu. This study has significant relevance to the situation of the energy-deprived
rural areas of Zimbabwe. Due to the geographical constraints, the national electric grid of Vanuatu does not reach the small islands consisting of an archipelago of approximately 65 islands. In an attempt to provide access to energy, solar power is utilized via solar home systems that are comprised of a photovoltaic kit and a battery for domestic use. Chow’s (2010) study concentrates on the impact this project had on the population of Vanuatu.

Although the scope of the two studies are different, the methodology is fundamentally identical whereby a project is assessed for a desired variable, and cross evaluated to its respective phase. Having two scholarly examples of this methodology renders the evaluation matrix as a viable form of an assessment tool to evaluate the outcomes of a development project. Furthermore, the significant relevance of the problem/solution relationship in Chow’s (2010) creates a stronger case for the credibility of the evaluation matrix.

The results gathered from this chapter will assist; policy makers and key stakeholders, both in governmental and commercial venues, academicians and practitioners that are interested in developmental studies, and most importantly future researchers. The results will aid in understanding the effectiveness of a certain project from a sustainability standpoint, and therefore offer a crucial review of its viability. The sustainability guidelines are an assortment, derived from the mission statement of BipBop program, and my personal voluntary experience as an engineer at SNV in Harare, Zimbabwe.
The following section will serve as an exploratory chapter to better explain the details pertaining to the main concepts utilized within the methodology framework, which heavily relies on the definition of sustainability, and the specifics of the project life-cycle timeline.

*Sustainability: A Critical Framework*

As the world leaps across the turn of another century, new challenges appear at every step. New problems arise that are more complex and require a unique set of expertise to diagnose. Since the Brundtland Report (1987), a new philosophy made its first public appearance and inspired many scholars and researchers. This new ideology was unique in the sense that it was multi-faceted and demanded advanced knowledge of the environmental, social, and economical sciences. Sustainability, a unifying point between those aforementioned social sciences, seeks to overcome the challenges of poverty, climate change, and virtually any other issue related to the quality of life (Asheim, 1994). Today, sustainability has outgrown its infancy stage and is gradually making its way into viable agendas worldwide, seeking answers for problems our planet is currently facing. This unifying and unique philosophy has been paramount in the context of development studies, given its interdisciplinary structure and humanitarian objectives. The United Nations, one of the first international organizations to embrace this new theory, has been an active body in realizing sustainable development projects and prioritizing this concept in the international arena.
Although the literature still suggests that there is no unified definition for sustainability that is agreed upon by different stakeholders, the theory of sustainable development has been widely accepted as a theory that objectifies human development and equity, whilst mitigating the harmful effects towards the environment (Waas, Verbruggen, & Wright, 2010). The problem of defining sustainability increasingly becomes a primary concern, as the methods and frameworks to measure the outcomes of sustainability related projects are not inclusive (see Figure 2).

Figure 2. Sustainable Development, an Interdisciplinary Approach.

The lack of an inclusive framework creates barriers to effectively monitor and evaluate sustainable development projects. Providing access to energy for rural Zimbabweans will surely benefit the economic activity within the surrounding regions, due to extended store hours of local businesses, ability to create value added products, and possibly the creation of small cottage industries.
Schneider Electric’s BipBop Program aims to strengthen the development goals of low-income areas by providing access to energy by utilizing renewable energy technology. The outcome of this project cannot be justified by solely evaluating the rate of economic activity, or the number of photovoltaic-kits that have reached rural Zimbabweans. This impediment in measurement therefore highlights the need for a framework that can effectively evaluate and assess the outcome of sustainable development projects carried out in Zimbabwe, and other low-income areas.

Currently, sustainability related projects are evaluated using Life Cycle Assessment (LCA) analyses to acquire results relating to the ecological footprint of a product or service from its very start until its completion (Guinée & Heijungs, 2005). LCA is commonly used by industrial ecologists and practitioners in environmental management. One of the primary challenges society is facing is the transition from a fossil fuel dependent lifestyle to a more environmentally friendly one. Businesses, among other fields, are also in the process of transition towards a sustainable future, whilst expanding customer base and product range. Integrating the assessment of environmental management is an indispensable tool to arrive at a conclusion about a product or service’s ecological performance. These results will typically justify for the environmental aspect, however there two other pillars within sustainability; the economic, and the social pillars that need to be addressed for a feasible evaluation. LCA geared towards products, incorporate virtually every impact there is on the environment, from the resources used in the beginning at the extraction stage of raw materials, until the waste-stage of a product where it is finally discarded. The analysis also encompasses the emissions of toxic fumes
used in transportation between facilities, and until the point it reaches the customer. This exhaustive cycle is also known as cradle to cradle (McDonough & Braungart, 2010). There is ongoing research to extend the use of LCA by adding other various factors to arrive at more accurate results (Guinée & Heijungs, 2005).

*Timeline of the project: The Project Life-Cycle*

An inclusive sustainability assessment timeline is required to examine the performance, and understand the impact of sustainable development projects. The project life-cycle involves the classification of a series of operations required to complete a set of objectives. Although versions and styles differ greatly from industry to industry, this method has been used quite frequently in industry and is a preferred tool to manage and explain the different stages of a project (Pinto & Slevin, 1988 and Kerzner, 2013). Irrespective of the subject or the size, most projects may be ordered in the project life cycle structure (see Figure 3) (Kerzner, 2013).

This section will provide a deeper understanding of the project life-cycle timeline that will primarily be used to divide a project into its respective parts. The methodology followed in this study is aimed at implementing a life-cycle timeline and aligning it within a sustainability framework to better understand and evaluate the feasibility, impact, and measure the outcomes according to the availability of data.
Applying these principles of Project Life-Cycle lists (see Figure 3) will enable users to perform evaluations and better understand the impacts of a sustainable development project at any given stage. This evaluation will point out strengths and weaknesses and aid in assessing a need for improvement.

The first stage of the project life-cycle is Initiation. This starting point encompasses the general scope and the goals of the project, the motivation and the problem-solution statement. In case of Schneider Electric’s Project in Zimbabwe, the problem statement can be described simply as the lack of access to energy in rural Zimbabwe and how this impedes with development. The solution then being, Schneider Electric BipBop Program, that provides access to energy utilizing renewable energy sources.
Once the scope of the project is clearly defined, a formal project planning phase begins. This involves the review of the situation in the pilot area, including the population, economy, and social equity, to better understand the requirements and necessary tools. Guidance from local partners, such as NGOs and governmental bodies are crucially supportive as well. This stage is then followed by the mobilization of products and services to initiate the actual plan. In the case of Schneider Electric’s Project in Zimbabwe, the quantities of photo-voltaic kits that are to be distributed are an issue that has to be addressed.

The execution or implementation of the project is comprised of realizing the project and following the procedures outlined prior. In case of Schneider Electric’s Project in Zimbabwe, this entails the community outreach, technical training and presentation of the In-Diya Photo-Voltaic LED Lighting Kit (Appendix I).

Finally, the closure stage, as self-explanatory, is the concluding stage of the Project Life-Cycle although it may include revisions to the previous stages such as additional training on the technical side of the equipment, basic accounting skills, marketing, and entrepreneurship skills. At this point, Schneider Electric is assumed to have distributed the LED lighting and Photo-Voltaic kits, and are steadily advancing in the stage of operations in rural Zimbabwe, proving access to energy to those that are in need.
Figure 4. Modified Project Life-Cycle Stages.

The Evaluation Matrix Dimensions: Modified Project Life-Cycle

In order to effectively evaluate the sustainability level of a development project in its preliminary stage, prior to execution, an inclusive evaluation matrix is necessary. Since the BipBop Program has not yet been initiated in Gutu, Zimbabwe, the Project Life-Cycle method cannot be fully functional. And therefore cannot provide accurate results. Instead, a more appropriate “Modified Project Life-Cycle” will be utilized to assess the sustainability level. This matrix will ensure the assessment of each item in the matrix dimensions. These items are part of the sustainable-development framework, and relate to the vital stages of a potential project.

This method will enable practitioners and researchers to pinpoint the positive and negative aspects of a project. The dimensions of the evaluation matrix are based off of,
and defined by the Project Life-Cycle Timeline. These include; (1) The Feasibility of The Project, (2) Effectiveness of Measure, (3) Theoretical Connectedness, (4) Maintainability & Support. The items will be utilized to evaluate according to the specific time range of the project. The details pertaining to these four items will be further discussed in the following paragraphs.

*The Feasibility of the Project*

Evaluating the viability of project is paramount. A successful development project is expected to provide an intelligible solution to a problem that has been defined. Extension of the national electric grid of Zimbabwe of is an effective solution hypothetically, but the effectiveness of this plan today is arguable considering the situation of the rural Zimbabweans in Gutu District. This item will evaluated with accordance to the feasibility of the project that is to be initiated.

*Effectiveness of Measure*

Steps that gradually elevate a project to meet its intended purpose are the corner stones of a grand structure. Considering the outline of the BipBop Program, the measure taken as a proposed solution has crucial impact on the success of the overall program. As there are other possible measures that could be employed, this item will explore the usefulness of the In-Diya PV LED Kit and analyze how well the proposed solution and problem correlate.
**Theoretical Connectedness**

This stage refers to the ability to adapt the conceptual plan to the conditions described in the problem statement. This is perhaps the most important step that can greatly alter the outcome of the project. A strong overlapping connection must be present to achieve the desired positive outcome. Types of equipment, supplies, restraints, and problem-solution relationship are all necessary items can affect the results and may be the crucial factor that determines the success.

**Maintainability & Support**

Once the project has been implemented and operationalized, the customers that have acquired the Schneider In-Diya LED Lighting Kit are dependent on the reliability of the product. This stage evaluates the implications of the project when it has been initiated. Due to the lack of spare parts and support, this project may have positive or negative unintended consequences.

**The Evaluation Matrix Dimensions: Sustainable Development Items**

The other dimensions that are targeting the assessment of sustainability are based off of Figure 1 with the intention being to provide a cohesive analysis of the factors of sustainability, which is indispensable when reviewing a sustainable development project. This matrix dimension is composed of; (1) Community Outreach/Participation, (2) Economic Benefits, (3) Social Equity, (4) Environmental Factors, and (5) Impact on
Value Creation. The details pertaining to these four items will be further discussed in the following paragraphs.

*Community Outreach/Participation*

This item is selected to account for the social and human development within the rural community. The primary objective is to empower the rural Zimbabweans and extending their abilities to make positive changes in their communities.

*Economic Benefits*

This will aid in clarifying the net economic benefits of the community members in Gutu District, Zimbabwe. Though economic development and benefit are not viable sources to justify the performance of a sustainable development project, it is a necessary item that has to be improved to create a sense of empowerment that will eventually lead to a positive outcome in the overall scope of development. It can also be measured through an increase in average income.

*Social Equity*

The case of social equity lies on the base of assessing the impact of providing affordable, and sustainable energy solutions to those rural Zimbabweans that are in need. One of the objectives of sustainable development is to achieve equality on a societal level and this item will aid in understanding how a sustainable development project will impact social equity.
Environmental Factors

One of the major components of sustainability, and the ideology behind the creation of LCA of products is the impact on the environment. This sustainable development project aims to provide clean energy and sustainable solutions that harness energy from renewable sources.

Impact on Value Creation

This factor will assess the effect “Access to Energy Program” has on the creation of value. The sustainable development path foreseen for Zimbabwe also entails the growth of economy and certain industries. As highlighted in the literature review, gaining access to value-chains and forming a cluster, and progressing towards the global value chains are meaningful endeavors for a developing country like Zimbabwe.

The Evaluation Matrix

Upon defining the dimensions, the resulting matrix is shown in Table 1. The matrix dimensions were defined based on the findings of Labuschagne and Brent (2005). Their research suggests that the matrix dimensions have to adhere to the scope of the overall project and must be aligned with a time-line. With the BipBop Program, the project concentrates on sustainable development and value creation, hence the items within “Sustainable Development Items.” This matrix framework allows for each item, listed in the dimensions, to be evaluated with accordance to the timeline of the project. With this tool, practitioners and researchers can both visually and intuitively comprehend
the strengths and weakness of a certain sustainable development project, and ascertain areas that might need improvement.

Table 1. The Sustainable Development Project—Evaluation Matrix.

<table>
<thead>
<tr>
<th>SUSTAINABLE DEVELOPMENT ITEMS</th>
<th>MODIFIED PROJECT LIFE-CYCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Feasibility of Project</td>
</tr>
<tr>
<td>Community Outreach/Participation</td>
<td>(1,1)</td>
</tr>
<tr>
<td>Economic Benefits</td>
<td>(2,1)</td>
</tr>
<tr>
<td>Social Equity</td>
<td>(3,1)</td>
</tr>
<tr>
<td>Environmental Factors</td>
<td>(4,1)</td>
</tr>
<tr>
<td>Impact on Value Creation</td>
<td>(5,1)</td>
</tr>
<tr>
<td>Total</td>
<td>15/15</td>
</tr>
<tr>
<td>Min. Score/Item</td>
<td>1</td>
</tr>
<tr>
<td>Max. Score/Item</td>
<td>3</td>
</tr>
</tbody>
</table>

**Scoring Guidelines**

The evaluation matrix will be scored based on the evaluator’s assessment of how the items are impacted through the sustainable development project. Each item in the dimensions is crossed between the “Sustainable Development Items” and “Project Life-Cycle” to account the impact of each individual. The evaluator will grade each element with a numerical value from (1 – 3). This means: A numerical value of (1) being low impact, close to no effect. A numerical value of (2), being a moderate effect, and, a
numerical value of (3) being a high impact (see Table 1). This will result in a maximum total score of 15 per item listed on the “Modified Project Life-Cycle.”

As per the case of Schneider Electric’s BipBop Program in Zimbabwe, these elements will be evaluated based on my personal experience as voluntary engineer at SNV, one of the local partners of Schneider Electric, which has assisted the BipBop Program with facilitation and implementation of the preliminary tasks. These experiences are based on observations of; villages in Gutu District, Zimbabwe, and the technical training phase of the Photo-voltaic Kits in Harare, Zimbabwe.

Scale

Once the scores have been assigned for each item in the Modified Project Life-Cycle Stage, the overall results have to be evaluated to determine the level of Impact the project has. This step will ensure precise analysis for each respective stage of the Project. Since the minimum available points per the Project Life-Cycle Stage are 5, and the maximum 15, the scale for determining the level of impact has been designed accordingly. “Low Impact” ranges from (0 – 5). “Moderate Impact” ranges from (5-10). “High Impact” ranges from (11-15).
Table 2. Impact Scale for Determining Effect of the Project.

<table>
<thead>
<tr>
<th>Impact Range</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>11-15</td>
</tr>
<tr>
<td>Moderate</td>
<td>6-10</td>
</tr>
<tr>
<td>Low</td>
<td>5</td>
</tr>
</tbody>
</table>

Given the defined matrix dimensions, the items that represent the “Sustainable Development” portion of the assessment will be analyzed with accordance to the project stage. This time-line has been constructed to ensure a precise measurement at a given project phase, and is represented by the “Modified Project Life-Cycle”. This structure ensures the evaluation of each defined sustainable development item and therefore enables an accurate assessment of the potential implications of the BipBop Program in Zimbabwe. Each item will be rated according to the scale in Table 2 (shown above). The results for each section will then determine the impact BipBop Project has on sustainable development in Zimbabwe.
DATA ANALYSIS

*Examining the Sustainability of the BipBop Program*

The assessment of Schneider Electric’s project on rural electrification in Zimbabwe was made possible through my voluntary participation with SNV at Harare, Zimbabwe. SNV was one of the local partners of Schneider Electric, and aided the BipBop Project by assisting with the facilitation, and providing crucial insights on the rural communities of Zimbabwe. Though my involvement, I was able to partake in site visits in the rural villages of Gutu District and directly perceive the situation of the energy deprived households. Furthermore, I was able to attain local insights on potential solutions, and personal views of the community members, through informal conversations. The site visit was only scheduled until the afternoon and did not extend until the evening due to the difficulties in limited visibility, and navigation through unpaved and unlit roads.

Moreover, participating in the technical presentation and training of Schneider’s In-Diya PV kits in Harare, as well as being exposed to the rural environment alongside Schneider Electric representatives, was another major factor that aided in gaining insights on the BipBop Projects. All these experiences added up had considerable influence on understanding the potential impacts on rural Zimbabweans.

As mentioned previously, the evaluative assessment of this project is based on my aforementioned observations. These also include informal conversations with the
community members, Schneider Electric representatives, and other representatives from various development agencies.

**Pilot Area: Gutu, Zimbabwe**

Gutu District is one of the largest districts in Masvingo Province and has a population of approximately 200,000. It is situated in the north of the province and is 140 miles south of the capital, Harare. The majority of the rural population is occupied with farming, mainly tobacco and potatoes. Members of this energy deprived community in Gutu live a modest lifestyle, coping with all the difficulties that electricity has overcome years ago.

*Figure 5. Seven districts of Masvingo Province, Gutu (in blue), 2006.*
There are however, other sustainable solutions that are widely used and accepted. The parabolic dish, which is mostly used for heating water, is a solution that is utilized throughout the village. Meals are usually prepared using wood fire and greatly lack in sanitation. Another major issue is the storage of food: There are no methods for effectively storing prepared meals.

Figure 6. Solar Parabolic Heat Dish, Gutu, Zimbabwe. 2013.

Previously, there have been humanitarian projects that were aimed at implementing irrigation schemes that used water from nearby dams. This irrigation project, initiated by Oxfam, has had a positive impact on the farmers’ livelihood and the rural community. The success of the irrigation project has highly motivated the community members to seek out solutions to their existing problems (Oxfam, 2012). The
proposed solution of PV kits are greatly appreciated and highly anticipated by the community members.

It is crucial to ascertain the impacts the project will have on the community members and households. However, the scope of this work is to gain better insights on the influence of such development projects that apply renewable energy engineering concepts. Therefore, this study will scrutinize the BipBop Project on a broader scale.

The analysis section will be utilizing the evaluation matrix that enables the assessment of the BipBop Project in Gutu, Zimbabwe. The measure is composed of the In-Diya Photo-Voltaic LED and Battery Kit that is to be distributed by Schneider Electric. In order to gain a better understanding of how this initiative impacts sustainable development in Gutu, the “Sustainable Development Items” will be cross analyzed with the “Modified Project Life Cycle” stages.

This analysis will yield a numerical score that will be interpreted according to the “Impact Scale”. The result will theoretically assess the impact of the project and justify its position within the grand scheme of sustainable development.
The BipBop Project in Gutu, Zimbabwe was assessed using the Evaluation Matrix. The results of the project are shown in Table 2. The BipBop Project scores highest for the “Theoretical Connectedness” stage (14 points/15 points) of the “Modified Project Life-Cycle” and equally level (13 points/15 points) for the “Feasibility of Project” and “Effectiveness of Measure”. The “Maintainability and Support” stage scores a relatively lower score of (12/15). The overall results indicate a “High Impact” on development for the overall preliminary assessment of the project as all four stages of the “Modified Project Life Cycle” items scored within the bounds of “High Impact” (10 points - 15 points).
The evaluation for the project was executed and assessed per the “Modified Project Life-Cycle”. This method enables the valuation of the BipBop Project according to its theoretical components that lie within the preliminary assessment.

Feasibility of Project

The “Feasibility of Project” stage scored (12 points/15 points) and resulted in a “High Impact” classification. The project outline of providing access to energy by sustainable means is highly related to the objective of Schneider Electric Corp. BipBop Program. Moreover, considering the lack of access to energy in Gutu, Zimbabwe, this situation makes a perfect problem-solution relation and scores perfectly. It is expected that this project will result in higher transaction rates and economic benefits for the local community in Gutu, due to the extension of store hours, and other various products technology has to offer. Fresh produce, frozen goods, and several electronic items such as radios and televisions will have the necessary infrastructure to operate.

The “Social Equity” item scored the lowest (1 point/3 points) within the “Sustainable Development Items”. This is due to the uncertainty that arises concerning the social dimensions and how such a project affects the social balance within the community. Since there are a limited number of PV kits, not all community members may reap the benefits of direct access to energy.

As the BipBop Project in Gutu, Zimbabwe encompasses the use of renewable energy and efficient lighting modules (LED Kits) the “Environmental Factors” item
scores perfectly and ensures high environmental performance. Photovoltaic kits harness energy from the sun, and therefore are considered both sustainable and renewable.

“Impact on Value Creation” item has scored (3 points/3 points) and therefore considered “High Impact” as well. Desroches and Andre (2012) project growth in value creation, due to an extended range of new products and services that will be available with the access to energy. These include, televisions, radios, and other items such as sewing machines.

Effectiveness of Measure

As the problem was defined as the lack of access to energy in Gutu, Zimbabwe, the proposed solution of electrification via sustainable methods is an accurate measure. Due to this cohesion, “Effectiveness of Measure” stages scored decent and thus considered “High Impact” with (12 points/15 points). Community participation is at an utmost priority level and requires outreach from local Zimbabweans to further the project. The selected entrepreneurs for the In-Diya PV LED Kit are also required to keep community participation at high levels for their own profitability, that will in turn, create value and foster further economic development. This cycle is echoed in the results section for “Effectiveness of Measure” as; “Community Participation”, “Economic Benefits”, “Environmental Factors”, and “Value Creation” scored a (3 points/3 points).

As was the case for the feasibility section, the “Social Equity” item scored the lowest (1 point/3 points) for this section as well. The reason is due to the same problem
concerning the uncertainty that arises regarding the social dimensions and how this electrification project affects the social equilibrium within the community.

_Theoretical Connectedness_

Since the problem-solution relationship concerning the lack of access to energy is evident from studies Schneider Electric has conducted (Desroches and Andre, 2012), the overall “Theoretical Connectedness” portion of the analysis reflects the literature and scores considerably high with respect to the other stages. This result supports the theoretical framework of the BipBop Program and their initiative in Gutu, Zimbabwe. The “Sustainable Development Items” all, except “Social Equity”, score (3 points/ 3 points) reinforced by the mission and vision statements of the BipBop Program:

“…bring[ing] safe, clean electricity to the people who need it most Worldwide. The programme addresses three key issues in an effort to achieve the environmental, social, and business outcomes that are essential to any successful sustainability initiative.” (Desroches and Andre, 2012).

Compatible with previous stages of the “Modified Project Life Cycle” the “Social Equity” item of the “Sustainable Development Items” score (2 points/ 3 points) and thus considered “Moderate Impact”. This is due to the lack of theoretical support and justification for impact on the social equilibrium in Gutu, Zimbabwe.
Maintainability and Support

This stage of the project is the final stage of the preliminary assessment, which is reflected by the “Modified Project Life Cycle”. The overall score for this stage is (12 points/15 points) and thus considered “High Impact” on sustainable development. This portion is detailed on the reliability aspects of the In-Diya PV LED Kits, and especially during the distribution period. Although a few complications on the maintenance and support features are present, such as lack of spare parts and trained service personnel, the “Maintainability and Support” will create further economic benefits and value creation because of this very lack of parts and service. It is expected that this need will arouse other entrepreneurs, proposing solutions for problems that may be encountered. Due to this relation the “Economic Benefits” and “Value Creation” items score (3 points/3 points) and the; “Community Participation”, “Social Equity”, and “Environmental Factors” score (2 points/3 points).
CONCLUSION

The role of renewable energy in sustainable development has reached a new level. With an environmentally conscious population rising around the world, the concept of sustainability has been a sought after strategy, often proposed as a solution, for a wide range of global issues. Energy, and the services energy enables are well embedded in our daily lives. Almost every task is carried out directly, and sometimes indirectly, utilizing equipment that require energy. These services are essential to human beings and countries; access to energy is also a means for clean water, communication, clean and efficient lighting, healthcare needs, transport, and a dozen more essential services that can be translated into positive economic and social outputs.

The scope of this study was intended to examine and synthesize the relationship between, global value chains, sustainability, and development. It was found that presently, in an environmentally conscious era, the supply networks are increasingly pressured by non-governmental and institutional bodies to adopt and promote environmental, social, and economic transparency in their respective operations. The three pillars of sustainability, which are also inevitably linked to issues in development, have become the stepping stone for scholars interested in global matters of concern, such as poverty and income inequality (Hansmann, Mieg & Frischknecht, 2012).

The literature suggests that this transparency is carried out to improve the social welfare of a society. Increased demands require robustness and oblige businesses to constantly strive to better serve customers via any means that improve process efficiency. Striving for perfection, and mitigating any sort of waste to accomplish ultra-high
efficiency causes many complications; especially in working conditions and human rights, and social values. The supply chain networks today are growing quickly, and ever expanding over international boundaries where social values can be infringed upon. This existing awareness on social, environmental, and economical spheres in sustainability and supply chain can be transferred into instruments that assess implications of implemented development programs that seek to create value and shift low-income regions into suppliers in the global value chains.

In this context, Zimbabwe, as a developing low-income area, is an ideal location to initiate these interventions. With the BipBop program, Zimbabwe, will experiment with the creation of value and sustainable development to achieve higher developmental goals.

The rising trend, reflected by the interest in academic journal articles in the new area of “Sustainable Development”, indicates a growing interest. Although this high density gives birth to different viewpoints from diverse fields, the variance causes some deviation in the meaning of the term “Sustainable Development.” For the purpose of assessing the developmental project of the French Energy Company, Schneider Electric, “Sustainable Development” has been defined in this paper as a means of development that ensures the mitigation of pollution and harmful effects on the environment and society. This new ideology, if applied expertly, will assist the situation of Zimbabwe that has suffered many hardships from its colonial history, political turmoil, and instable economy. The study conducted by Desroches and Andre (2012) show positive impacts on the sustainable livelihoods in Peru, and India, following the BipBop In-Diya PV LED Kit
Projects. For the case of Zimbabwe, it is projected that the access to energy will empower the community members. With the extension of business hours, ability to store perishable items by refrigeration, and ability to operate electrical devices such as radios and televisions, a foundation is built on which local entrepreneurs can further build and develop. Through this cycle, it is expected that small economies belonging to small Zimbabwean towns and villages will join with the grand scheme of value chains and connect into the GVCs to construct sustainable supply chains.

The literature suggests that the creation of value is paramount for smallholders to buy in GVCs. With the scope of the BipBop Project and Schneider Electric Corporation’s dedication for a sustainable future, Zimbabwe will be setting grounds for growing sustainable supply chains in the future.

The results show that Schneider Electric’s BipBop Program is likely to have a “High Impact” on sustainable development. All four of the “Sustainable Development Items” have scored 12 points, or above, and are thus considered to have a “High Impact on Development” according to the scale in Table 2. These results, which are focused on the preliminary stage of the project, can aid in predicting the likeliness of success by achieving the set goals.

Schneider’s project is also likely to impact the health sector, creating a positive effect on human development via lighting solutions. Based off the previous success Schneider has displayed in India and Peru, it is expected that the Photovoltaic LED lighting project will benefit the rural communities and neighboring towns. According to the data presented by Desroches and Andre (2012) extended store hours show a direct
positive relationship with an increase in transaction. Furthermore, it is argued that this model is a self-perpetuating cycle once initiated. Considering the past interventions by other actors in Zimbabwe, which haven’t shown much improvement, this new initiative launched by a dedicated energy management company proves to be a more effective formula for the future of an emerging, young, and energetic nation.

There are several limitations in the analysis portion of this framework. While the Evaluation Matrix offers assessment for each matrix item, it does not take the weight factor into account. This is an important restraint that may alter the accuracy of the analysis. Furthermore, the installation stage of the project may experience other complications that might not have been planned for. The installation and operation stages of the project also have to adhere to the previously planned layout and follow the same principles to remain sustainable. Therefore, the development of a more precise and accurate methodology to determine sustainability factors is paramount.

Another limitation that arises with the evaluation stage is the scoring system. Since the scoring system is evaluated by an assessor, the results cannot be replicated and therefore fall short for arriving at precise data. Moreover, conditions may not be agreeing with the matrix dimensions in other projects.

Despite the limitations of this analysis-framework, the matrix evaluation tool offers a unique method to ascribe greater understanding of the potential implications of a sustainable development project that may not otherwise be measured.

Overall, this work offers a distinct technique of analyzing social, economic, and environmental pillars within the context of development projects. “Sustainable
Development Items” and “Modified Project Life-Cycle” lists crucial indicators that are vital for understanding the implications on the social, economic, and environmental dimensions. The life-cycle analogy was modified to better fit the needs of preliminary assessments and considers each stage thoroughly. While this “Evaluation Matrix” was primarily intended for initial assessment, it can be altered and modified to better fit the conditions for an assessment tool that evaluates the installation and implementation stages of other development projects. This work also serves as an important form of evidence that highlights the complexities that are present in development studies.

Most importantly, this work synthesizes theories involving sustainability, development, and value chain literature. It offers an alternate lens for development studies and aids by intertwining the three distinct fields. The matrix evaluation tool enables the assessment of a development project in its preliminary stages, and projects the impact it is likely to have on a community in Zimbabwe. This relationship is critical as the impact level of a sustainability project directly relates to the outcomes, which in turn, enables the creation of value (Desroches & Andre 2012). It is through the active participation as a dynamic supplier in the GVCs that Zimbabwe will develop and prosper.

Since the matrix evaluation framework only yields results for the preliminary stages, it is difficult to state whether the theoretical connections made in this study are working or not. The major findings are however, that a “high impact” on a sustainable development project yields the ability to create value, which in turn can be further developed and traded across international boundaries through GVCs. The inability to
arrive at discrete results on the performance of the theoretical formulation is another constraint that arises with the utilization of such a framework.

Recommendations for future research in the field of development include, but are not limited to, further analyzing the implications of business and economics principles, and how they can be utilized to create new frameworks to analyze future problems in eradication of poverty, and human development.
REFERENCES

Africa in the World Economy in B. Brende (Chair), *From Tigers to Lions?* Symposium conducted at the meeting of the World Economic Forum, Addis Ababa, Ethiopia.


Desroches, G. V., & Andre, T. (2012). The BipBop programme: Providing access to reliable, affordable and clean energy with a combined approach of investment, offers and training. Field Actions Science Reports. The journal of field actions, (Special Issue 6).


APPENDIX A

TECHNICAL SPECIFICATIONS OF IN-DIYA PHOTO-VOLTAIC LED KIT
In-Diya – Efficient Lighting Solution

Operating voltage: 90V – 250V AC/ 50-60Hz, 12V DC

Light Output: Equivalent to 11Watt CFL (Compact Fluorescent Lamp)

LED Life: 50,000 hours

Battery: 12V, 5Ah

Power consumption by LED: 5.5 Watt when operated on AC supply, 4.5 watt when operated on battery (solar charged).

*Figure 7. The In-Diya Photo-Voltaic (PV) Kit LED and Battery Kit.*