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# URBAN SUSTAINABILITY TRANSFORMATIVE EFFECTS OF GREEN ENERGY INFRASTRUCTURAL TECHNOLOGIES IN THE AFRICAN CONTINENT

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The African continent just like others has joined a band wagon in the adoption and use of technologies that promote the production of green energy. Among the renewable energy infrastructure technologies worth noting is the landfill-gas to electricity investments that have been embraced by a few African countries since the advent of the new millennium. The technologies have been adopted not only to improve economic performances of the African continent but also to realise social and environmental benefits that accrue from the innovations. This article assesses the urban sustainability benefits that have been realised in South Africa and Cote D'lvoire as a result of the transformations that have taken place in green energy infrastructural technologies. Specifically, the study applies case study research designs and mixed method approaches to understand the socio-economic and environmental benefits that have been realised through the adoption and application of landfill gas to electricity generation and supply infrastructural technologies in two cities of eThekwini (South Africa) and Bingerville (Cote D'lvoire). Interviews, photographic surveys and focus group discussions helped to reveal that innovative projects have resulted not only in improved municipal solid waste management but more importantly urban environmental conservation, social and economic and improvements particularly of the urban and impoverished families that participate in the projects. To this end, the paper recommends the adoption and scaling up of innovative infrastructural technologies in renewable energy projects. Lessons that are being learnt from the best practices need to be replicated in other African countries and similar projects need to be encouraged, initiated and supported.

*Keywords*: Climate change, green economy, innovation, renewable energy, sustainability.

## 1 INTRODUCTION

The relentless decline of traditional energy sources; related price volatilities and environmental impacts associated with the heavy utilisation of oil and coal for industrial and domestic purposes have imperatively raised the need for the search, development, adoption and use of alternative energy sources (Hall *et al*., 2014). Consequently, the world over, there has been a gradual shift to embrace renewable energy sources to improve energy efficiency and security, reduce the cost of energy and environmental impacts such as global warming and climate change. Whilst the study acknowledges the myriad potential of various renewable energy technologies for Africa spanning from Wind, Solar, Nuclear, Bioenergy, and Hydro and landfill gas, specific attention is placed on landfill gas to electricity projects in the African continent. The paper in particular discusses the urban socio-economic and environmental benefits directly emanating from the development, adoption and application of innovative technologies that generate renewable energy from landfill gas in eThekwini, South Africa and Bingerville, Cote D'lvoire. It starts by highlighting the conceptual and theoretical aspects that build up this work and goes on to outline the research methodological approaches that were adopted to operationalize this work. The research findings are then presented and discussed in detail highlighting the various benefits that accrue to urban centres in the African continent as a result of the adoption and use of green energy infrastructural technologies. The novel insights suggest ways of improving management systems and processes to improve benefits and reduce or recover costs of modern and innovative renewable energy technologies in the African continent, to emulate the levels that have been reached in developed countries.

## 2 BACKGOUND

Just like in other continents that make up the developing World, African countries have joined the band wagon in the adoption and use of technologies that promote the production of green energy and also improve the access to energy and energy security within the continent (Barry et al., 2011). Although the contributions of African countries to global greenhouse gas emissions are much smaller than that of industrialized and transitional countries, there is a growing realisation that Africa is likely to be disproportionately affected by the impacts of climate change (Karekezi *et al*., 2003). Consequently, the current challenge faced by the African continent is to transform the energy mix by decreasing the continents' heavy dependence on fossil fuels; hence the need for rapid and widespread applications and use of low-carbon energy technologies (Barnsley & Ahn, 2014). According to Gillingham and Sweeney (2012), efforts to adopt new technologies and to improve the efficiency and efficacy of existing technologies are central to resolving the impasse in non-renewable energy production and use. Accordingly, the adoption and use of technologies that promote the production of green energy come as a direct result of a decline in traditional energy sources, price volatilities and associated environmental impacts associated with the heavy utilisation of oil and coal for industrial and domestic uses (Mathew & Lave, 2000). According to Uyigue and Archibong (2010), green energy technologies give rise to renewable energy sources and environmental conservation. There is also no doubt that such a development result in improved social, economic, human and technological development in developing countries.

The availability of affordable and renewable energy enables spectacular growth of economies and humans in the continent. Thus assuming new economic equilibriums; there is need to take into consideration eccentric sources of renewable energy such as hydro power, solar, landfill gas and biofuels that are renewable. Currently, there is over reliance on non-renewable energy resources in the African continent, although there is a realisation that there is great potential for renewable energy sources since most developing countries are endowed with the resources (Bhattacharya & Jana, 2009). According to Tall (2010) the common energy mix in the African continent consists of natural gas, coal and oil energy and the energy is generated mainly from coal (46%), gas (23%), hydro (18%), oil (11%) and nuclear (2%). However, these energy resources are unevenly distributed throughout the continent, for example oil is mostly found within Nigeria, Algeria, Egypt and Libya, whilst coal is commonly found in South Africa. The very limited availability of electricity combined with affordability issues to electricity services in most countries in the African continent has made access to electricity by most Africans elusive (commission on sustainable development-14, undated). As a result of scarcity of energy resources in the African continent, very few countries are energy exporters; while the majority is net energy importer. The reliance on energy imports results in poor energy security in most African countries (Economic commission for Africa, undated), hence the continent has increasingly been developing more interest in renewable energy technology investments not only as a way of dealing with global environmental concerns but also to improve energy provision and security.

## 3. CONCEPTUAL ISSUES

Green energy sources are derived from resources that are replaceable. They include energy such as wind, hydropower, photosynthetic energy that is found within biomass and these are generated indirectly from the sun. They also include sources that are directly derived from the sun such as solar energy and also those that are generated from natural movements such as geothermal and marine energy. Green energy sources have the potential to supply more than 3000times the world's current needs, with solar topping the list with more than 2000times, wind over 200 times, biomass more than 20 times, geothermal 5 times, marine 2 times and hydro times 1.

The generation and use of green energy sources have promoted the development and management of urban centres lending them the sustainability that is fundamental.

### 3.1 Biomass power technologies

Bioenergy is generated when organic materials such as plants, trees, crops that store the energy from the sun through the process of photosynthesis are converted into electricity, heat and liquid fuels. Besides they promote social and economic development particularly for agro based nations many of which are developing. The technology keeps rising and the future looks bright, with European countries, the United States of America, China, India and very recently the African countries expanding the generation and use of bioenergy.

*Landfill gas to electricity*

Municipal solid waste that is disposed on landfill sites emit greenhouse gases such as methane, carbon dioxide when they decompose, thus contributing to global warming and climate change (Jaramillo & Mathews, 2005). Traditional, landfill gases have been captured and flared to reduce methane emissions, odours and improve air quality around landfill sites (Ruiz et al., 2013). This has been practised to observe commitments and requirements of the Kyoto Protocol and subsequent COP meetings, with the just ended COP 21 in Paris, in France. In the past few decades innovative infrastructural technologies have been adopted to generate electricity from landfill gas rather than flaring it (Hall & Scrase ,1998). Besides the environmental benefits of flaring gas, generating renewable energy from landfill gas give rise to economic and social benefits. Anaerobic decomposition of the organic component that is found within municipal solid waste disposed at landfill sites gives out methane, carbon dioxide and nitrogen gases (Qin *et al*., 2001). The promotion of landfill gas to energy projects results in the reduction of methane gas emissions and the captured gas is used to support economic activities, as it is used in industrial processes and the operations of electricity generating equipment (Bove & Lunghi, 2006). As soon as landfill starts operating, the infrastructural technologies have been designed and the site receives municipal solid waste, landfill gas begins to be captured (Demirbas, 2009a). The capturing of gas take place for about 30 years after the landfill site has been decommissioned in terms of receiving waste.

### 3.2 Hydroelectric power technologies

Hydroelectric power is generated using the system of turbines that convert the energy of water moving due to gravity from higher to lower elevations in sources such as dams and lakes (Ellabban *et al*., 2014). The technology is well established and flexible hence it is applicable in small projects that generate few watts that are commonly found in the African continent to mega hydropower projects that produce several thousands of watts for example those found in Brazil, Russia, Canada, China and the USA (Wang & Yang, 2011).

### 3.3 Solar energy

Solar power technology uses the sun to generate either electricity or heat through photovoltaic (PV), concentrating solar power systems (CSPS) or solar thermal systems respectively (Ellabban *et al.*, 2014). The PV systems use a modular system where PV cells, inverters, batteries, electrical components, and mounting systems are connected to convert solar energy directly into electricity. Silicon systems are the commonly established solar PV technologies, however thin film modules with non-silicon semiconductor materials have also entered the market (Brankera *et al.*, 2011). The CSP technologies generates electricity by directing sunlight through reflection to a medium that is used in the process of generating electricity for example liquid, gas or solid is heat and used in the process of power generation. According to Singh (2016), solar funding for solar infrastructural technological projects is still a great challenge in most developing countries as governments support is either still very little or hard to get, whilst private financial institutions such as banks still view solar technology as very risk and the majority poor households that need to use solar technology as small scales are considered unbankable.

### 3.4 Wind Energy

Wind power technology uses wind turbines to convert the kinetic energy of moving wind into mechanical first and then electricity (Eltamaly, 2013). The technology has been improving over the years, particularly the turbine designs and shape to maximise the capture of kinetic wind. Onshore wind turbines have been in existence for a long time and relatively large wind power plants have been established giving rise to what is commonly known as wind farms (Kaygusuz, 2009). On the other hand, offshore wind turbines have come on board recently leading to massive wind power plants using large turbines to generate high quality and reliability electrical conversion systems (Islam *et al*., 2013).

### 3.5 Marine power technology

Renewable energy from oceans is generated from several sources such as tidal range and currents, waves, ocean thermal energy and currents (Ben elghali et al., 2007 ).The marine technologies are still in their infancy in terms of implementation hence a lot of research and development in the technology and infrastructure are in progress, particularly in the United Kingdom and the United States of America and if successful the potential of these technologies will exceed the current and future energy needs.

### 3.6 Geothermal power technology

Geothermal power technology generates green heat and electrical energy through the use of heat pumps and power plants to extract thermal energy stored within rocks, steam and liquid water stored within the earth's interior with high temperatures. Hydrothermal systems that are dominated by liquid and vapour, conductive systems that include rock and magma as well as deep aquifers with circulating fluids make up geothermal energy sources (Ellabban et al., 2014). The commonly used form of geothermal energy source in countries such as the United States of America, Indonesia, Mexico, Philippines is hydrothermal and its application and effectiveness is set to increase in the near future.

## 4 OPERATIONALISING THE STUDY

This work applied a coterie of research tools to gather, process and analyze data (Rossman & Rallis, 1998) on the impact of green energy infrastructural technologies in transforming and sustaining environmental, social and economic situations of South African and Cote D'lvoire urban communities. A Mixed-method research paradigm was adopted to facilitate the gathering of quantitative, qualitative and spatial data from the two cases; eThekwini and Bingerville municipalities. According to Barbie and Mouton (2010), case study research designs assist in identifying the target population, data collection, analysis, interpretation and reporting. Primary data was largely gathered from the two cities was gathered using interviews of key informants and relevant stakeholders (Leedy & Ormrod, 2010) that were identified from government ministries/departments, private sector organisations, the central government, non-governmental organisations and also community based organisations that are involved in the landfill gas to electricity projects. Field work data was also gathered through the use of geographic positioning system surveys that revealed the spatial existence and distribution of landfill gas to electricity projects within the two countries. Data was also collected through observations and photographic surveys which assisted in generating fresh data from the field.

Qualitative, quantitative and spatial data gathered from the field was analysed using appropriate tools and techniques. Quantitative data was analyzed through the use of statistical software packages that include excel whilst qualitative data was analyzed through content analysis. Spatial data captured using a GPS was analyzed through the use of ArcGIS software package to reveal the locational characteristics and relationships of components of the landfill gas to electrical energy technologies.

## 5 GREEN LANDFILL GAS TO ELECTRICAL ENERGY INFRASTRUCTURE AND THE TRANSFORMATIONS IN AFRICAN CITIES

Most African countries are facing fuel deficits that is resulting in costly energy imports (Frost & Sullivan, 2009). Landfill gas to electricity projects may greatly assist the African continent to reduce energy import bills. There are a number of factors that are considered when designing and establishing landfill gas to electricity projects that include the years of operation of the landfill site that determines the volume of waste disposed and the likely amount of gas to be captured from the site (Jaramillo & Mathews 2005). The configuration of the landfill site is very important in the design of the landfill gas to electricity projects as wells and a system of vertical and horizontal pipes that capture and transport the gas to the engines need to be installed and these depend on the depth of the landfill site (Escobar et al., 2009). Choices are made on the appropriate engines that should be used to convert the gas to heat and electrical energy, since they have different costs and efficiencies (Ravindranath & Balachandra, 2009). The commonly used are the reciprocating internal combustion engines the so called IC engines that burn the gas by combining it with oxygen in the process running the engines connected to crankshafts that triggers the turning of generators that in turn produces electricity. In some circumstances, gas and steam turbines burn landfill gas that is used to heat up compressed air that powers turbines that drive generators that, as in IC engines, produce electricity.

## Benefits of Green Landfill gas to electricity in South Africa and Cote D'lvoire

Green energy infrastructural technologies result in massive transformations in urban centres that among others include environmental, economic, social and institutional. The article unpacks the overarching essential and imperative impact of renewable energy technologies in shaping the social and economic wellbeing of the ordinary people within African communities that are being implemented. The work specifically investigated the selected innovative renewable energy technologies where landfill gas is converted to electricity technologies in generating employment and improving livelihoods, fighting poverty, reducing inequalities in Bingerville, Cote D'lvoire and EThekwini, South Africa beyond their primary objectives of reducing global warming and mitigating climate change and pollution. It assesses the urban transformative benefits that have accrued in South Africa and Cote D'Ivoire as a result of the adoption and use of green energy infrastructural technologies. The cases under discussion offer a grand opportunity to consolidate the results of studies that have been conducted in Ethekwini, South Africa; the first country to implement the municipal solid waste to energy in the African continent (Gumbo, 2014). The studies push the frontiers of knowledge generation to greater lengths, as it focuses not only on the impact of the eccentric technologies to environmental conservation and preservation but also on socio-economic transformation of communities. The current cases are unique in that the projects are part of the first striking examples of approved clean development mechanism projects on municipal solid waste to energy in the African continent. Since the inception of the projects there has been limited evidence on how they have been contributing to socio-economic and environmental benefits.

In South Africa the Bisasar road project which is the largest registered CDM project in the waste handling and disposal space (Frost & Sullivan, 2009). The objective of these projects is to extract land fill gas and combust it by flaring. Other CDM projects based in EThekwini are the Marian and La Mercy landfill sites. The landfill sites have a combined capacity of 7.5 MW (see Table 1). The projects have gas extraction wells installed, vertical and horizontal gas pipes, flare systems and gas generators installed.

**Table 1: Landfill Gas to Electricity in South Africa and Cote D'lvoire**

| Name of country | Name of Landfill site | Landfill gas to electricity | Total |
|---|---|---|---|
| **1.South Africa** | a. Marianhill | 1 MW | |
| | b. Bisasar Road | 6.5 MW | **7.5 MW** |
| **2.Cote D'lvoire** | a. Bingerville | 1.5 MW | |
| | b. Akouédo | 0.5 MW | **2 MW** |

(Source: Field Studies 2013)

Gas collector wells are drilled in the landfill to suck the gas that is transported to all the pipes to the gas pump and flare station. The gas is converted into electrical energy by the turbines and a step up transformer is used to assist in feeding the electricity of the same voltage into the municipality's grid (Gumbo, 2014).

In Cote D'Ivoire the main CDM projects are the Akouédo landfill rehabilitation and electricity generation project and the Bingerville CDM project .The Akouédo-Abidjan Landfill Rehabilitation and Electricity Generation Project is a natural ravine where urban and industrial waste have been dumped since 1965 with no suitable environmental measures(Tall, 2010). The Abidjan Municipal Waste-to-Energy Project located in Bingerville, North of Abidjan commenced in 2009. It was developed under the Kyoto Protocol's Clean Development Mechanism and approve by the United Nations Framework Convention on Climate Change (UNFCCC). The project is owned by the Société Ivoirienne de Traitement des Déchets (SITRADE), with project funding structured and arranged by Ecosur Afrique and the African Biofuel and Renewable Energy Fund (ABREF) whilst the Economic Community of West African States Bank for Investment and Development (EBID) is the major project sponsor. The project seeks to collect and treat 200 000 tons of urban waste per year using anaerobic digesters, using the resulting biogas to produce electricity and the residual waste being transformed into compost. A number of stakeholders are involved with the project, and the list includes the Abidjan Municipal Waste-To-Energy Project team; the Abidjan and Bingerville cities, The Clean Development Mechanism National Authority (AN-MDP); The Ministry of Mines, Petroleum and Energy; Office for the Promotion of Energy Efficiency (Bureau des Économies d'Énergie); the Sub-Directorate of Energy Control and Renewable Energies (Sous-Direction de la Maîtrise de l'Énergie et des Énergies Renouvelables); Energie Electrique de Côte d'Ivoire (EECI); Société d'Aménagement Urbain et Rural (SAUR) and Electricité de France (EDF); Compagnie Ivoirienne d'Electricité (CIE); the National Authority for the Regulation of the Electricity Sector (L'Autorité Nationale de Régulation du secteur de l'Electricité de Côte d'Ivoire, ANARE). Also the Ministry of Higher Education and Research; Research Institute on Renewable Energies (IREN); Société de Gestion du Patrimoine du Secteur de l'Electricité (SOGEPE); Société d'Opération Ivoirienne d'Electricité (SOPIE); Autorité Nationale de Regulation (ANARE) are involved. The Ecosur Afrique; African Biofuel and Renewable Energy Fund (ABREF) and the Economic Community of West African States Bank for Investment and Development (EBID) are the project planners and sponsors; Project owner Société Ivoirienne de Traitement des Déchets (SITRADE). Bingerville has an energy mix of biomass at 50%, oil at 35%, gas at 14% and hydroelectricity at 1%. The waste is collected and treated; after collection and sorting the waste is treated through anaerobic digesters. Resulting biogas is used to produce electricity while residual waste is transformed into compost (Tall, 2010). The landfill gas to electricity projects have several benefits (See Figure 1). These among others include economic, social, environmental, institutional and physical.


**Figure 1: Strands of Urban Transformative Effects of Landfill Gas Projects**

Economically, the landfill gas to electricity projects in South Africa generate a total of 7.5 MW of electricity and that is supplied to 3 750 houses in the city at a rate of 500 houses per 1 MW. This has gone a long way in generating income of the municipality. Specifically, the projects have generated R 48 million through the selling of certified carbon credits which have put the province at an economic advantage. The CDM project is estimated to generate a total of R400 million during its life (Gumbo, 2014). It is no doubt evident that the CDM is indeed economical beneficial as the project assist in reaching the economic pillar of sustainability. The same has been experienced in Cote D'lvoire where the generated electricity has gone a long way in generating revenue for the municipalities and helped to reduce their costs of accessing energy. The lower economic benefits are offset by government incentives and also support from international organisations and private sector companies that invest in the projects thus making the landfill gas to electricity projects attractive, as they have higher environmental and social benefits

Social benefits of landfill gas to electricity are also realised as the incomes that are generated and the improved health of citizens, as emission and flaring offsets set in, hence the benefits to society justify the involvement of governments in subsidising the landfill gas to electricity projects (Shin et al., 2005).

Socially, the standard of living of the urban poor situated around the Bisasar road landfill site in particular has been changed as they are now benefiting from the proceeds of the landfill gas to electricity projects. The projects have also led to employment creation particularly during the construction of the plant, 57 unskilled labourers, 38 semi-skilled people were employed, and 11 skilled were also engaged during the construction phase of the project. At project inception about 14 skilled associates were employed. Education support to previously disadvantaged black students was given as about 3 male black students were given bursaries and 1 female black student to study civil engineering at UKZN. Recycling of materials at Bisasar road landfill site has created employment for some local poor residents as reclaimers are able to sell collected waste to the informal recycling market**.** Cote D'lvoire has also recorded the same social benefits as poverty levels to those that are directly and indirectly involved in the projects have been reduced.

It has long been observed that landfill gas to electricity projects yield higher environmental benefits than any financial costs and revenues. The costs of setting and establishing the technology and running the project is normally very high such that economic benefits are lower than expected due to in most cases the low prices of electricity, hence reductions in emissions become very worthwhile (Demirbas, 2009b). Environmentally, the quality of air has improved, there is now clean water, clean land which has led to environmentally safe, socially inclusive and economically productive cities (Lia & Tiberiu, 2010). The projects have chiefly led to the reduction of greenhouse gas emissions by the equivalent of more than 71 000 tons of CO2 per year. Specifically, the South African projects have led to over 200 000 carbon emissions reductions every year. To date the landfill gas to electricity projects have generated in excess of 600 000 carbon credits. The projects have also reduced the burning of coal by 80 000 tons every year and decrease the amount of methane and carbon dioxide in the atmosphere that are the main contributors of climate change. Leachate treatments at the landfill sites and also conservancy and plant rescue units (PRUNIT) have helped to reduce contamination of land and underground water as water purification that is recycled is used to irrigate plants at the sites**.** The same can be said about efforts to preserve the environment in Cote D'lvoire as a direct result of these landfill gas to electricity projects.

Physically, there have been massive developments of infrastructure within the cities emanating from huge investments within the landfill gas to electricity projects. Such investments in physically infrastructure lend the cities beautiful and sound development outlook.

Institutionally, several organizations that are efficient and innovative in their approaches have been set up to run the projects in their different capacities hence giving rise to reliable and effective institutions within the cities. The developments of strong partnerships among public, private and non-governmental organisations have also created strong capacities within the cities, as tackling the serious energy shortages becomes manageable.

## 5 RECOMMENDATIONS

Urban centres in the African continent, particularly the capital cities are experiencing high urbanisation as they continue to receive millions of migrants every year, giving rise to high concentrations of the urban population that consume more energy sources and generate high volumes of waste (de Ligneris, 2013). In the world over, efficient and proper disposal of waste that is generated by urban centres is a great challenge (Simelane & Mohee, 2012). Besides, improperly disposed wastes on landfills contribute to global warming as greenhouse gases such as methane are released in the atmosphere as the waste decomposes (Basura et al., 2012). Clarion calls to seriously consider increasing financial, technological and human resources mobilisation for the purposes of generating value and beneficiation from municipal solid waste are relentlessly being made in academic discourses and debates. One of the uses that solid waste has been put to use successfully, particularly in developed countries is to generate renewable energy. This work has demonstrated the importance of generating electricity from landfill gas, particularly its contribution to the improvement of the management of municipal solid waste more so in African countries. Even though African cities face serious challenges, they still remain centres of prosperity and places where human beings find satisfaction of basic needs and access to essential public goods. Efforts need to be made to tackle the challenges currently being experienced, such as the haphazard disposal of MSW; in order to improve well-being and prosperity and expanding on the prospects. This can only be achieved through green energy technological innovations in approaches and adopting flexible initiatives. There is a need to strengthen the capacity of relevant institutions through improving human, technical and financial resources and ineffective institutional arrangements. This involves the strict observation of rules and regulations, formulating relevant policies and implementing them to their letter and essence. There have also been initiatives to promote the participation of local as well as international players in the management of MSW.

## 6 CONCLUSIONS

The African continent just like others has joined a band wagon in the adoption and use of technologies that promote the production of green energy. Among the renewable energy infrastructures worth noting is the landfill-gas to electricity technologies that have been embraced by a few African countries since the advent of the new millennium. The continuous decline of traditional energy sources; related price volatilities and environmental impacts associated with the heavy utilisation of oil and coal for industrial and domestic purposes have imperatively triggered the drive to search for the development, adoption and use of alternative energy sources. It is a fact that the global production of conventional oil has declined and prices remain unstable as they always shift unreliably. On the other hand, coal that can be sometimes be regarded as a possible alternative has its own serious shortcoming of contributing significantly to global warming and climate change. This has led to the realization that the majority of systems upon which modern civilization depends on are not sustainable and therefore need to be changed to avoid self-destruction. In the quest to ameliorate the negative developments emanating from the heavy reliance on fossil fuels, there has been a surge in the development, adoption and utilisation of renewable energy technologies and investment policies in both the developed and developing worlds. Adopting a case study and phenomenological research design and applying mixed-methods approaches, this study focuses on the socio-economic and environmental benefits directly emanating from the development, adoption and application of innovative technologies in renewable energy generation and supply. The article in particular assesses the experiences of municipal solid waste to energy innovative technologies in two African countries; South Africa in the Southern African region and Cote D'lvoire in the western region of the continent. It specifically evaluates the direct and indirect benefits of electricity that is generated from gas projects being run in the two cities of eThekwini and Bingerville that are found within these two countries. Findings have revealed that the innovative projects have resulted not only in improved municipal solid waste management but more importantly urban environmental conservation, social and economic and improvements particularly of the urban and impoverished families that participate in the projects.

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