



# **Biogas Energy Solutions**

***Creating a Sustainable Future***

Africa at night, as seen from space is dark and empty. With almost 1 billion people, Africa holds over a sixth of the world's population, however it only generates 4% of global electricity. And three quarters of that electricity is used by: South Africa, Egypt and other coastal North African countries.

***-The Economist***

Access to cheap energy underpins modern societies. Finding enough to fuel industrialized economies and pull developing countries out of poverty without overheating the climate is a central challenge of the 21st century.

***— Michael Wines, New York Times***

## **Global Enterprise Experience 2009**

### **Team 8.**

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# ***Contents.***

<b><i>Executive Summary</i></b> .....	3
<b><i>Business Overview</i></b> .....	4
<b><i>Market Analysis</i></b> .....	5
<b><i>Threats and Risks</i></b> .....	6
<b><i>Competitive Advantage</i></b> .....	6
<b><i>Business Strategy</i></b> .....	7
<b><i>Marketing and Sales</i></b> .....	7
<b><i>Human Resources</i></b> .....	7
<b><i>Business Sustainability</i></b> .....	7
<b><i>Objectives</i></b> .....	8
<b><i>Financial Overview</i></b> .....	9
<b><i>Sources of Capital</i></b> .....	9





## ***Executive Summary***

**Electricity plays a very important role in the socio-economic and technological development of every nation. The electricity demand in Nigeria is far greater than the supply and the suppliers are unreliable. The country is faced with acute electricity problems, which is hindering its development. It is widely accepted that there is a strong correlation between socio-economic development and the availability of electricity. <sup>(1)</sup>**

**Agriculture accounted for 20% of all greenhouse gas emissions in 2001. Biogas Energy Solutions aims to reduce these emissions by the proper management of agriculture wastes. <sup>(2)</sup>**

Biogas Energy solutions (BES) offer a clean low carbon emitting technology for the efficient management and conversion of agro-industrial wastes into clean biogas.

Employing an Anaerobic Digester (AD) and Combined Heat and Power generator to combust the biogas produced for electricity generation and using this to feed micro-turbines then the energy they produce to sell back to the national power grid.

This provides communities with incentives to recycle agro-industrial waste and the opportunity for income for the community.



<sup>(1)</sup> Energy for Human Development, Report 1, [http://www.idiom.com/~garcia/EFHD\\_01.htm](http://www.idiom.com/~garcia/EFHD_01.htm)

<sup>(2)</sup> Food Choices and Climate Change, News, [www.common senseorganics.co.nz](http://www.common senseorganics.co.nz)



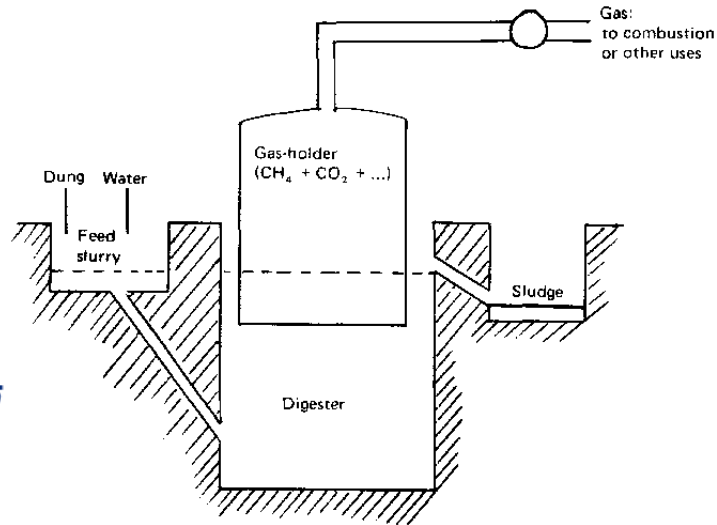
## Business Overview

### Electricity Shortage

Nigeria – like most of Southern Africa experiences frequent blackouts. This is crippling the country's ability to develop. The country has an abundance of natural resources but due to poor planning most of their natural gas is exported or flared rather than used supply the country itself.

### Biogas Energy Solutions

Biogas Energy Solutions seeks to take advantage of the pre-established electrical/gas infrastructure and set up Biogas plants in Nigerian communities.



Taking advantage of agricultural wastes and using an anaerobic digester to convert them into Biogas we seek to support communities in creating power, and also reduce greenhouse gas emissions from the agricultural sector.

The organic materials needed for producing biogas range from firewood, agricultural wastes, animal wastes, and human wastes. We propose to set up these biogas plants as close possible to the required fuel.

Many Nigerian communities have abattoirs that average 20 head of cattle per day, Using the waste from these animals and others we can not only fuel the digester but safe management of these wastes can reduce greenhouse gas emissions. The digester also yields high quality sludge fertilizer that can be used for crops.

This gas can be injected into micro-turbines and mixed with compressed air. The hot pressurized gases that result from combustion are forced out of the combustion chamber and through the turbine wheel, causing it to spin and turn the generator thus producing electricity.<sup>(3)</sup>

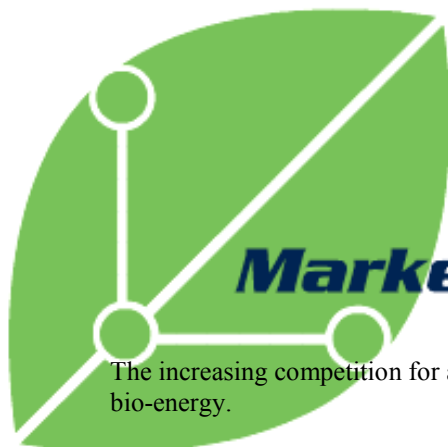


Measuring the output of these turbines and how much electricity is fed back onto the grid, we intend to charge the government for the use of a stable power supply, which can supplement existing power supply, or act as a reserve during blackouts.

As locals will run the plants, the communities will receive shares of the profits, which will be re-invested, back into each community that has an established Biogas plant.

BES headquarters will be situated in Nigeria, hardware such as digesters will be made locally (when possible) which will contribute to the economic development of the area, and specialist equipment will be shipped from our foreign suppliers.

<sup>3</sup> Micro turbines, Gas Engines Link Biogas to the Grid, 2006, [http://www.jgpress.com/archives/\\_free/001066.html](http://www.jgpress.com/archives/_free/001066.html)



## Market Analysis

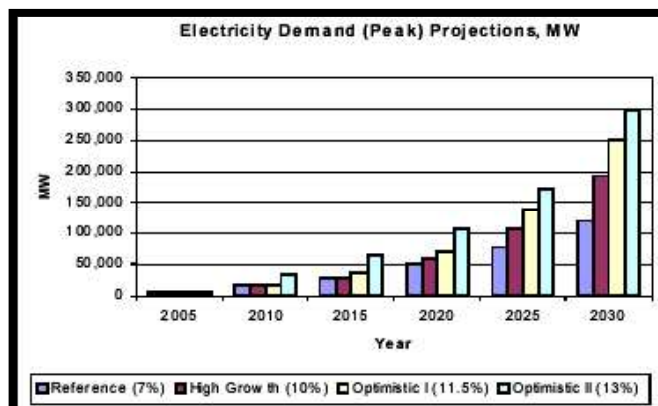
The increasing competition for access to the dwindling stocks of fossil fuels has increased the competitiveness of bio-energy.

The potential market for biogas energy in China, Nepal, Pakistan and India is put at about 1.5 billion dollars according to a report by Caleb Management Services of Bristol. This market is expected to grow by about 60% following projections that livestock-related methane emissions will increase by that amount in the period 1990 – 2030<sup>(4)</sup>. Furthermore, the overall market may be able to grow further if a new business can offer new service dimensions that meet the needs not currently being served by existing competitors.

Nigeria, a sub-Saharan country in Africa, has a population of 140 million people.

The power generating stations of Nigeria are large scale and are hydro and thermally operated. The thermal stations which generate about 60% of the nation's electricity depends on fossil fuels which is a major source of greenhouse gases and also not sustainable at the rate at which it is being consumed.

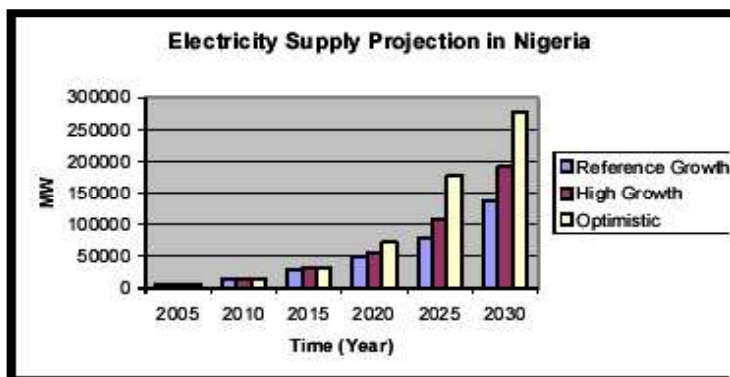
In 2001, generation went down from the installed capacity of about 5,600MW to an average of about 1,750MW, as compared to a load demand of 6,000MW. Also, only nineteen out of the seventy-nine installed generating units were in operation.<sup>(5)</sup>



These energy demand/supply<sup>(6)</sup> graphs show demand and supply based on various forecasted GDP growth. Using these graphs we can see that demand is greater than supply up until 2025 when it starts to even out. That gives 15 years of operations in a highly demanding market with few competitors.

With the demand for livestock products, which is expected to double during the first half of this century and excess energy demand, Nigeria is an excellent option for the pilot location of Biogas Energy Solutions.

As first language of the country is English, this also provides an easily navigable business environment compared to foreign language markets.



<sup>4</sup> CDM Potential for the Commercialization of the Integrated Biogas System, 2002, Caleb Management Services Limited, Bristol, United Kingdom.

<sup>5</sup> Matching Electricity Supply with Demand in Nigeria, 2008, International Association for Energy Economics.

<sup>6</sup> IAEA/ECN, 2007. Assessment of Energy Options and Strategies for Nigeria: Energy Demand, Supply and Environmental Analysis for Sustainable Energy Development (2000-2030).



## **Threats and Risks**

Threats that pose significant risks to our business include:

- Access to feedstock for biogas plants (digesters).
- Lack of public awareness as to the potentials of biogas.
- Cultural taboos surrounding the use of human and animal feedstock for clean biogas generation.

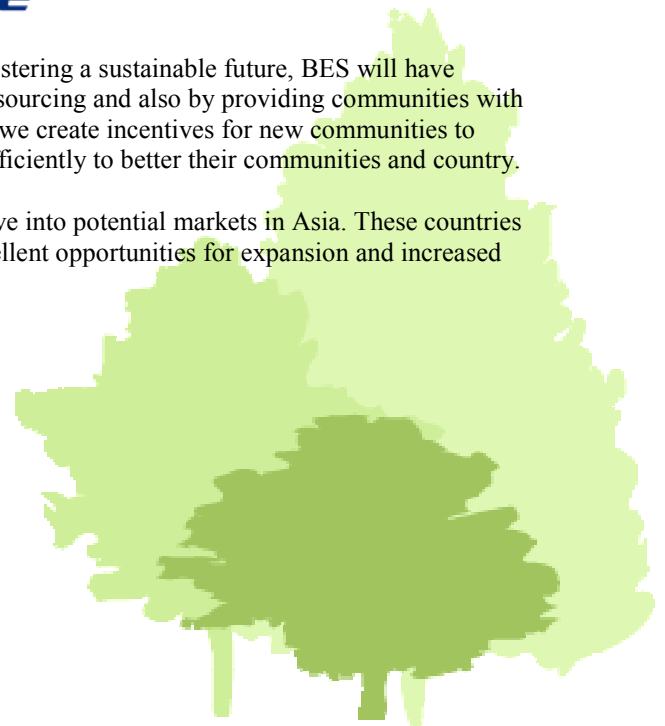
The implication of these threats is mainly low investment by governments and institutions in the biogas program promotion focusing on “technology fix” rather than an integrated system approach. We would respond to these threats by:

- Establishing Biogas plants close to communities’ sources of feedstock.
- Embark on aggressive public enlightenment as to the use of biogas.
- Drawing on international experience and progress to design a baseline and monitor projects that will allow carbon integrity to be maximized and realized.
- Working with governments of developing countries to establish bilateral agreements with governments of developed countries to finance the projects through the Clean Development Mechanism (CDM) of the Kyoto Protocol.
- Setting up a percentage share of energy sales to be injected into the local communities’ who have set up a biogas plant.

## **Competitive Advantage**

As a company that focuses on profit maximizing but also on fostering a sustainable future, BES will have competitive advantage in the market due to innovative energy sourcing and also by providing communities with shares of the profit from their biogas energy production plants we create incentives for new communities to adopt our system and already established systems to operate efficiently to better their communities and country.

Once BES has operations running in Nigeria, we expect to move into potential markets in Asia. These countries with large cattle herds and increasing populations provide excellent opportunities for expansion and increased profits, and further reduction of Greenhouse gas emissions.





## ***Business Strategy***

Our core strategy will be to provide a share of the profits from energy sold to the communities' who generated it. This strategy will make us focus on production, operation, and marketing but also align the ambition of the workers with that of our company. While our company will become recognized as highly competent in all areas of its business, we intend to be recognized as the clear leader in clean low carbon energy provision.

## ***Marketing and Sales***

Our marketing strategy will be focused on the developing countries of Africa and Asia with large livestock-keeping communities. We will adopt innovative marketing strategies such as using our established biogas communities to showcase to other communities what opportunities hosting a Biogas plant can create for them. Sales strategy will be based around a low-cost and reliable power source, which will serve the community in which it is based before others.

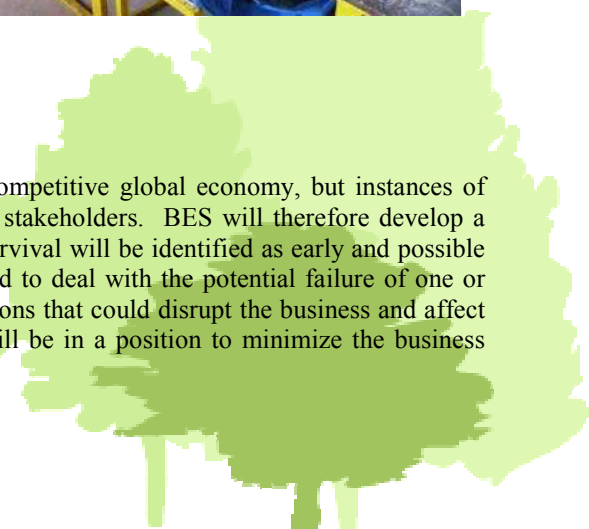
## ***Human Resources***

We recognize that human capital is an important asset. We will seek to train locals in daily operating activities with a long-term goal of the plants being fully operated by them. We will review each employee's performance regularly, and when possible promote from within. Our salaries and benefit packages will be competitive with those offered by other firms in our line of business. We also hope to help fund schools in the area to give back to the people who support the project and increase the human capital of the region. This will ensure educating, recruiting and developing a diverse workforce, through which we wish to establish a formula for success in the workplace, marketplace and society.



## ***Business Sustainability***

Sustainability is an essential part of any business in a dynamic competitive global economy, but instances of crisis are likely to erupt which may impact the organizations key stakeholders. BES will therefore develop a strategy where functions and processes critical to the company's survival will be identified as early and possible and consequent operational and contingency plans will be designed to deal with the potential failure of one or more of these. BES will be more sensitive to possible crisis situations that could disrupt the business and affect its operating expenses, profits and overall growth. In short, we will be in a position to minimize the business impact and financial damage.





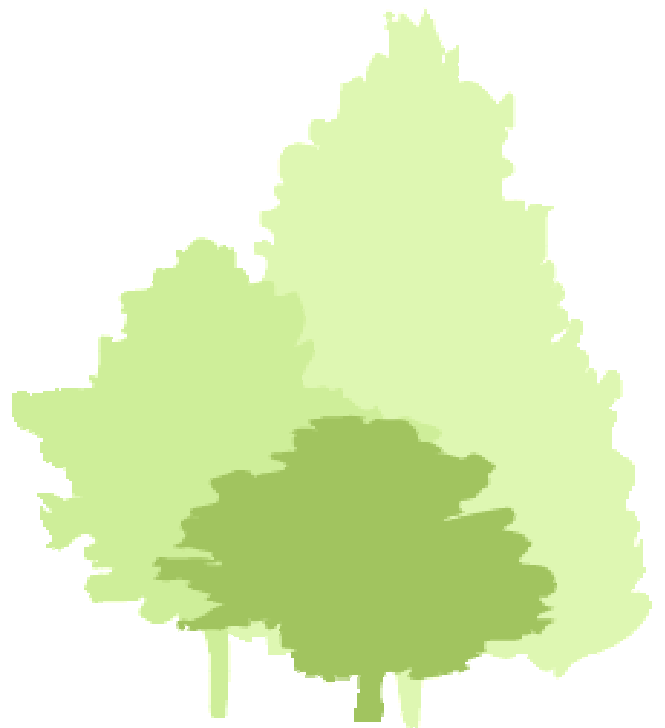
BES's main objective is to generate clean low carbon energy that meets the energy needs of developing countries. To achieve this we have short-term and long-term objectives.

### ***Short-term***

- Provide good practices strategies
- Provide training support and marketing services.
- Promote biogas energy to new stakeholders.
- Conduct information outreach to educate communities, policy makers and Anaerobic Digestion (AD) industry on opportunities and benefits associated with AD development in host countries.
- Conduct solicitation on AD development.

### ***Long-term***

- Encourage research activities on improving biogas yield and electricity conversion efficiency while reducing costs of AD.
- Develop AD using advance technologies (i.e. high rate at solid concentration, thermophilic temperature, and advantaged digestion design).
- Raise socio-economic status of host communities.





## Sources of Capital

We seek to gain funding for this project through the Clean Development Mechanism of the Kyoto protocol. This mechanism allows developed countries to invest in projects that reduce emissions in developing countries as an alternative to more costly emission reductions in their own country. We will also look to borrow half of our setup costs from a bank, and also look to large multi-national companies looking to invest in eco-friendly business as part of their corporate responsibility.

Costs (\$USD) (Per plant, per month)	
Micro-Turbines (per Unit. One off cost to purchase.)	\$30,000
Digester (One off payment for construction, including CHP)	\$2,500
Installation	\$500
Maintenance	\$60
Wages	\$160
Fuel for digester	\$100
Loan Re-payment	\$400
<b>Total</b>	<b>\$33,720</b>
<b>Cost to run per month.</b>	<b>\$720</b>

We will purchase the micro-turbines from Capstone Turbines<sup>(7)</sup> at a cost of 30k (USD) per unit. We will use local materials and labour to construct the digesters and train locals in maintenance and operations. The minimum wage in Nigeria as required by the National Minimum Wage (Amendment) Act 2000 is \$33(USD) per month.<sup>(8)</sup> Using four workers for daily operations we will pay an above average wage of \$40(USD) per month to provide communities with incentive to build and operate our plants efficiently. The low cost of labour reduces our start up costs and monthly wage bills.

The average cost to produce energy in Nigeria is put at around \$0.20(USD) per Kwh using diesel fuel.<sup>(9)</sup>

We foresee the ability to produce our electricity at a much lower rate than other providers due to the source of fuel. The Micro-turbines each have a capacity of 30Kw, depending on how much gas we produce we can sell energy for as little as \$0.11(USD) per Kw. We will need to produce 6,545 Kw to cover monthly costs, and produce 306.545 Kw to recoup our start up costs.

One 30Kw micro-turbine can produce 2,500Kw per day at peak gas production levels; this gives a monthly output of one unit at 75,000 Kw.

If the plants can produce enough gas to run the micro-turbines at full capacity we will make more than enough profit to cover our initial setup costs. We have provided a substantial monthly provision for the purchasing of bio-wastes to fuel our plant as part of our aim to maximise output.

Production	6 months@ Full gas capacity.	12 months @ full gas capacity	18 months @ full gas capacity	24 months @ full gas capacity
Using one turbine. (\$USD)	\$45,000	\$90,000	\$148,500	\$198,000
Using one Turbine (Kw)	450,000 Kw	900,000 Kw	1,350,000 Kw	1,800,000 Kw

<sup>(7)</sup> Capstone Turbines, U.S.A, <http://www.capstoneturbine.com>

<sup>(8)</sup> Minimum Wage (Amendment) Act, 2000, [http://www.nigeria-law.org/National%20Minimum%20Wage%20\(Amendment\)%20Act%202000.htm](http://www.nigeria-law.org/National%20Minimum%20Wage%20(Amendment)%20Act%202000.htm)

<sup>(9)</sup> Nigeria: IPP's and the PHCN Mantra, <http://allafrica.com/stories/200903020010.html>