Cows to Kilowatts

Dr. Joseph Adelegan, PhD, C.Eng.
Executive Director
Global Network for Environment and Economic Development Research
Ibadan, Nigeria
Phone: +2348062843428
Email: gneeder@yahoo.com
Global Waste and Energy Trends

• Global Energy System sits at the nexus of the deepest dilemmas of our time.

• Demand is likely to double over the half of this century.

• The volume of municipal and industrial waste is predicted to double by 2025.

• Renewable energy could provide 30% of energy demand by 2050.
The Slaughterhouse at Ibadan, Nigeria
Waste dump and cow led to the slaughterhouse
The Bioreactor
The Biogas Plant
Mission Statement

To eliminate pollution and associated diseases from slaughterhouse waste in Nigeria and to provide affordable clean energy for urban poor households as well as environmentally safe organic fertilizer.
Market Analysis

- **Total Addressable Market**
  The total urban market available is 92 million with a growth rate of 5.5%.

- **Target Market Segment**
  Urban households with per capita income less than USD 2 per day (55 million with a growth rate > than 5.5%)
Initial Beneficiary Attributes

- Urban poor household characteristics
  - Per capita income < USD 2 per day
  - Large household size ranging 6 to 10
  - Women work and make purchase decisions
  - Concentrated slums which lack safe water, sanitation and power supply
  - Currently using kerosene, fuel wood and charcoal
Cows to Kilowatts provides affordable and environmentally safe cooking gas and organic fertilizer to the urban poor and low income farmers. Unlike kerosene, wood and charcoal alternatives which are more costly and adversely affect human health and chemical fertilizers which pollute the environment, Cows to Kilowatts creates a virtuous cycle of sustainability that also eliminates slaughterhouse waste-borne disease.
### Project Investment Appraisal and Financial Sustainability Analysis using Discounted Pay-back Method

<table>
<thead>
<tr>
<th>Nature of the Abattoir</th>
<th>Design Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Oxygen Demand (COD)</td>
<td>4,000 mg/l</td>
</tr>
<tr>
<td>Wastewater Volume</td>
<td>3,500 m³/day</td>
</tr>
<tr>
<td>Size of the AFF Biogas Reactor</td>
<td>5000 m³</td>
</tr>
<tr>
<td>Estimated Land Area Required</td>
<td>0.08 Hectares</td>
</tr>
<tr>
<td>Biogas Production Rate</td>
<td>1,500 m³/day</td>
</tr>
<tr>
<td>Equivalent Volume of Biogas (Pure Methane)</td>
<td>900 m³/day</td>
</tr>
<tr>
<td>Equivalent Volume of Compressed Biogas (Pure Methane)</td>
<td>4.5 m³/day (4,500 Litres/day)</td>
</tr>
<tr>
<td>Size of Household Gas Cylinder</td>
<td>25 Litres</td>
</tr>
<tr>
<td>Total Number of 25 Litres Gas Produced</td>
<td>180 No. of 25 Litres/day</td>
</tr>
<tr>
<td>Price of 25 Litres Compressed Natural Gas in Nigeria</td>
<td>USD 30</td>
</tr>
<tr>
<td>Proposed Price of 25 Litres Compressed Biogas</td>
<td>USD 7.50</td>
</tr>
<tr>
<td>Cost of the AFF reactor Biogas Reactor</td>
<td>USD 60 / m³ of the Reactor</td>
</tr>
<tr>
<td>Cost of the 5000 m³ AFF reactor Biogas Reactor</td>
<td>USD 300,000</td>
</tr>
<tr>
<td>Cost of Appurtenances for the Biogas Plant</td>
<td>USD 120,000</td>
</tr>
<tr>
<td><strong>Total Cost of the Biogas Plant</strong></td>
<td><strong>USD 420,000</strong></td>
</tr>
</tbody>
</table>

### Capital Budgetting

| Estimated Daily Revenue from the Household Cooking Gas     | USD 1,350                              |
| Estimated Monthly Revenue from the Household Cooking Gas   | USD 32,400                             |
| Estimated Annual Revenue from the Household Cooking Gas    | USD 388,800                            |
| Proposed Annual Operation and Maintenance (O & M) Costs    | USD 77,760                             |

### Cash Flow

<table>
<thead>
<tr>
<th>Discounted Annual Revenue (Less Annual O &amp; M) Costs (20%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year of operation</td>
</tr>
<tr>
<td>2nd year of operation</td>
</tr>
<tr>
<td>3rd year of operation</td>
</tr>
<tr>
<td>Discounted pay-back period (years)</td>
</tr>
</tbody>
</table>

### Present Value of Cash Flow
## Financial Model - 3 Yr Cash Flow

### 3 Years Cash Flow Projection for the Ibadan Pilot Biogas Plant

<table>
<thead>
<tr>
<th>Year (n)</th>
<th>Capital</th>
<th>Biogas Sales</th>
<th>Revenue Projection</th>
<th>Expenditure</th>
<th>Cumulative Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Revenue</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Revenue</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fertilizer Sales</td>
<td>Interest on Total Revenue</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>480000</td>
<td>388000</td>
<td>12600</td>
<td>80000</td>
<td>($480,000.00)</td>
</tr>
<tr>
<td>2</td>
<td>388000</td>
<td>12600</td>
<td>60090</td>
<td>80000</td>
<td>$240,480.00</td>
</tr>
<tr>
<td>3</td>
<td>388000</td>
<td>12600</td>
<td>60090</td>
<td>80000</td>
<td>$288,552.00</td>
</tr>
</tbody>
</table>

Discounted Payback Period = 23 months < 2 Years
Income Drivers (3 Yr Plan) for 1st Biogas Plant

- **Total Income Yr 1 = $500,000**
- **Total Income Yr 2 = $400,000**
- **Total Income Yr 3 = $460,690**

- **Contributed Yr 1 = $500,000**
- **Earned Income Yr 2 = $400,600**
- **Earned Income Yr 3 = $460,690**

- **Biogas Sales Yr 2 = $388,000**
- **Biogas Sales Yr 3 = $388,000**
- **Fertilizer Sales Yr 2 = $12,600**
- **Fertilizer Sales Yr 3 = $12,600**
- **Interest Yr 3 Revenue = $60,090**
- **UNDP grant = $500,000**
Expense Drivers (3 Yr Plan) for 1st Biogas Plant

Total Expenses
Yr 1 = $500,000

Total Expenses
Yr 2 = $160,120

Total Expenses
Yr 3 = $172,138

Installation costs
Yr 1 = $500,000

O & M Costs
Yr 2 = $80,000

O & M Costs
Yr 3 = $80,000

Taxes
Yr 2 = $80,120

Taxes
Yr 3 = $92,138

Operation Cost
Yr 2 = $59,200

Maintenance
Yr 2 = $20,800

Maintenance
Yr 3 = $20,800
Cumulative Return on Investment in US $ for 1st Biogas Plant
Competitive Advantage

• Highly competitive price (25%) of the prevailing price for lifeline rate and 50% for other markets.
• Biogas is a cleaner burning gas than other products (natural gas and traditional fuels)
• Threat of new entrants is low because of high cost of technology investment and government support.
Cash Management

• Initial financing: *United Nations Development Program*

• Maximum financing:
  - *Yr 1: USD 500,000 (1st Biogas Plant)*
  - *Yr 2: USD 760,000 (2nd Biogas Plant)*

• The Biogas Plant has a productive life of 15 years
Metrics

Financial Sustainability
- Pay back period of 2 years
- The return on investment is USD 3.5 million over the productive life of 15 years

Social Benefits
- Affordable cooking gas leading to increase in disposable income.
- Reduction indoor air pollution decreasing infant mortality

Environmental Benefits
- Abatement of water pollution
- Reduction in greenhouse gas emission leading to a reduction in global warming
- Environmentally sound organic fertilizer
Partners