Biogas Utilisation from Landfill Sites and Anaerobic Digestion

Presented By David Cornish
Items Covered

- Background to ENER-G Systems
- Landfill gas basics
- Technology and equipment
- Project implementation structure
- Experience on similar projects
- REIPPPP Small scale
ENER-G Systems

- ENER-G Group global experience
  - Staff compliment of over 600
  - Over 580 CHP units installed
  - Over 120 MW of landfill gas projects
  - 46% market share in UK

- Locally ENER-G Systems experience
  - 9 Landfill gas to electricity projects
  - One has been running for 3 years selling power to BHP Billiton
  - Chloorkop biogas project Built
  - Robinson Deep and Marie Louise Biogas project Built
  - Submitted 1 bid in round 3 of the large scale REIPPPP
  - Submitted 1 bid in Stage 1 of the small scale REIPPPP
Biogas Production

Rule of thumb calculations

• 1 tonne of highly organic waste (expected in South Africa) will produce at least 6m³ of gas
• 100,000T of domestic waste in a landfill p.a. is 1MW
• 1MW generator requires 600 m³/hour of Biogas at 50% CH₄
Landfill Gas
Biogas Generation
(assessment of gas generated)

- The calculation of the amount of gas produced in a landfill site is NOT an exact science and can be influenced by many factors:
  - The input of waste per annum and the percentage or organics in the mix
  - The surface area and depth of waste.
  - How the site is lined and capped.
  - The amount of moisture and leachate handling systems.
  - The method of site filling and operation.
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<th>B Industrial (tonnes)</th>
<th>C Comm/Ind (tonnes)</th>
<th>D Domestic (tonnes)</th>
<th>Total Putrescible (tonnes)</th>
<th>Weight (tonnes)</th>
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Gas Production Curve

Nether Dallachy Landfill Site
Estimated Landfill Gas Output

- Gas Yield - Low
- Gas Yield - High
- 300kW
- 400kW
- 1150kW
- 1450kW
Using Landfill Gas
Installation of pipe work manifold arrangement
Robinson Deep
1.15MW – Generator
Generators
1030kW & 300kW Generators
Alton Landfill

400KW landfill gas project
Design Philosophy
Automated Operating Systems
System Integration
Operating Sites

22 Operational AD projects

20 MW installed capacity

510 000 operating hours
Why Bother utilising Landfill Gas?

- Methane from waste is a huge source of atmospheric methane throughout the world and in the SA it is the significant contributor to our greenhouse gas emissions.
- Methane venting to the atmosphere is 21 times more damaging to the ozone than the CO$_2$ emissions.
- Methane is a valuable fuel source
- Control of methane helps to reduce odours for those people living in and around a landfill site and maintain safe operating conditions.
Global Emissions

Total Carbon Emissions by Nation

Per Capita Carbon Emissions by Nation

China's total emissions lead the world, but when adjusted by its huge population, its ranking drops down the per capita list.

The United States is no. 1 for total emissions but Americans shrink down to a respectable rank in line with other industrialized nations.

Tiny Micronesia has the per capita but due to the need to import most manufactured goods—a reality also seen in many small island nations.
South Africa
Emissions By Sector

- Power (24%)
- Transportation (14%)
- Buildings (8%)
- Agriculture (14%)
- Industry (14%)
- Other Energy Related (5%)
- Waste (5%)
- Land Use (18%)

Total emissions in 2000: 42 GtCO$_2$e
CDM In A Picture
South Africa’s Energy Mix
REIPPPP Structure

Diagram:
- NERSA
  - Generation Licence
  - Financiers Direct Agreement
  - Financing Agreements
- Lender
- Independent Power Producer
  - Implementation Agreement
  - Power Purchase Agreement
  - Grid Connection Agreement
  - Shareholders Agreement
  - O&M Subcontract
- EPC Subcontractor
- Operations Subcontractor
- Municipality
- Energy Sponsors
## Small Scale REIPPPP

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<th>Stage 2 Bid Submission Phase</th>
<th>No. of MW</th>
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<td>Second Stage 2 Bid Submission Phase</td>
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<th>R/MWh</th>
<th>R900 (nine hundred rand)/MWh</th>
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<tr>
<td>Landfill gas</td>
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<td>R940 (nine hundred and forty rand)/MWh</td>
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REIPPPP
Bid process

First Stage 1 Bid Submission (Part B) 14/10/2013
Registration and provision of clause 9.10 information
Second Stage 1 Bid Submission (Part B) 10/02/2014
Third Stage 1 Bid Submission (Part B) 14/07/2014
Fourth Stage 1 Bid Submission (Part B) 09/02/2015

First Stage 2 Bid Submission by Selected Bidders only (Parts C and D) 14/04/2014
Appointment of Selected Bidders

Second Stage 2 Bid Submission by Selected Bidders only (Parts C and D) 23/03/2015

Part D Evaluation & BAFOs (if necessary)

Preferred Bidders Appointed

21/01/2015
08/12/2015
09/03/2016
07/12/2016
Green Projects
drowning in paperwork
Round Three bid
Ss-REIPPPP shortcomings

- Still to complicated and costly for small scale projects (1-5MW)
- Time frame is too long (>2 years)
- No certainty derived from stage one process
- Administratively top heavy (lots of contracts)
- Ring fenced Entities limits scalability
- Structure of the projects limited

- Biogas and landfill gas projects will find this process problematic with the DOE insisting on real rights Vs commercial rights in terms of the land on which the project is developed.
Contacts

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Fax: 0027 (0)31 5643802
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Bread Theory

• The number of plant bakeries has dropped to between 60 and 70 compared to 200 in 1991. They are nevertheless very efficient producers of bread.

• The total production of bread based on flour sales in 2003 was 2 800 million loaves (1 500 million white loaves and 1 300 million brown loaves). This is approximately 62 loaves for every South African during the year or nearly 3 slices of bread per day for each person. The market value was approximately R12 billion.

• The plant bakeries produced 1 400 million loaves or 50% of the total production. Their efficiency is illustrated by the fact that there are 8 500 employees in the plant baking sector. Each employee therefore provides the bread requirements for approximately 2 600 South Africans based on the fact that this sector supplied half of the South African bread market or 22,5 million people.

• Estimated 2012 per capita electricity consumption 457w