UEMP Workshop

Waste to Energy Toolkit

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Overview

- Introduction
- Study focus & deliverables
- Rationale
- Waste types
- Planning a biogas project
- Case studies
- Toolkit
- Technical (feasibility) report
- Policy & policy recommendations
- Conclusions

Study focus & deliverables

- Toolkit
  - Sustainability
  - Planning a biogas energy project
  - Legal framework
  - Policy recommendations
- Technical (feasibility) report
  - Technology and its applications
  - Municipal waste data
  - Description of feasibility model
- Case studies
  - 4 case studies
- Feasibility model
  - Spreadsheet, high user input

Rationale

- Economic, environmental, social sustainability
- Moving from end-of-pipe approaches to upstream interventions
  - Sewage treated on-site
  - Organic waste treated on-site
  - Why not co-digestion?
- Opportunities abound for ‘mid-stream’ interventions e.g. OFMSW at waste transfer stations

Waste types

RESOURCES

W/WATER / OFMSW / WEEDS

ABATTOIRS

COSTING IS SCALE DEPENDENT: <> 1 ML/DAY / <> 10 t/d

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Municipal Biowaste Processing

Annual benefits, 1 million people	Sewage	Sewage & OFMSW
LPG equivalent (t)	2,000	6,600
LPG savings (Rm)	26	85.8
OR elec savings (R)	4.6	20.5
OR petrol savings (R)	21.1	84.5
Algae biomass (tons)	11,000	35,000
Biodiesel value (Rm)	16	63
Fertiliser value (R)	22	55
CER value (R) (elec)	3.7	11

Planning a biogas project

- This section of the guidelines includes:
  - Project conceptualisation
  - Feasibility study
  - Project preparation
  - Planning and construction
  - Commissioning and start-up
  - Operation and maintenance

Case studies

1. Cato Manor (RSA)
   - Co-digestion – biogas & fertiliser (food production)

2. Petro SA (RSA)
   - Petrochemical WW – electricity (4.2 MW, 34 GWh)

3. Raylong (Thailand)
   - OFMSW – electricity (0.6 MW, 5 GWh) & fertiliser

4. Bran Sands WWTW (UK)
   - WasteWater (AAD) – electricity (4.7 MW) & fertiliser (agriculture)

Feasibility model - options

In this section of the tool, you need to select either a "Yes" or "No" for the various options, using the drop-down list. If you answer "Yes" to a question, you may be further prompted for an input.
Once you have familiarised yourself with some of the input data areas, you may wish to return to this sheet to select various options

1	Do you need to buy the land for the project?	No	*By answering No to both the questions regarding land, it is assumed that the land is already owned and the cost of the land will not be included in the analysis*
	If Yes, how much will the total cost for the land be?	R -	
	If No, will you be leasing the land?	No	
	If Yes, what will the annual lease costs be?	R -	
2	Are all the resources comprising the feedstock for the energy plant available at the site where the plant is to be established?	No	
	If No, what is the average one-way distance per ton of feedstock?		*Insert average 1-way distance (km/ton)*
3	Select Yes or No for the following biogas utilisation options:		
	Electricity only	No	*Please only select Yes for 1 option!*
	Electricity and heat	No	
	Thermal only (e.g. In a boiler)	No	
	Thermal only (for direct consumption similar to LPG)	No	
	If Electricity only, will you connect to the power grid?	No	
4	Do you plan to sell the fertiliser?	No	
	If Yes, will you sell it wet, or dried?	Dry	
	What price will you sell it for (ex energy plant)?	R -	*R/ton*

Model - input

RESOURCE DATA		
What types of wastes are available for digestion?		*any combination is OK*
- WW	Yes	*If Yes: GO TO WW INPUT SHEET*
- OFMSW	Yes	*If Yes: GO TO OFMSW INPUT SHEET*
- weeds	Yes	*If Yes: GO TO WEEDS INPUT SHEET*
- abattoirs	5	*If Yes: GO TO ABATTOIR INPUT SHEET*
BLOOD, CONDEMNED MEATS, MANURE, WATER		
FINANCIAL DATA		
Electricity rate to users	0.385	*R/kWh*
Interest charged	13.5%	%
Exchange rate	11.0	*€1 : Rx*
Maintenance & insurance on energy plant	0.25	*R/kWh produced*
Feed-in Tariff	0.90	*R/kWh*
Discount rate	10.0%	%
TECHNICAL DATA		
Electricity used for production	6%	*% of that generated, 6% is typical*
Mass of Methane	0.67	kg/Nm3
Brut Energy Potential of Methane	14879.21	kWh / tCH4
CHP Electrical Energy Potential (η=36.8%)	0.37	kWh / tCH4
CHP Heat Energy Potential of Methane (η=46.5%)	0.47	kWh / tCH4
Efficiency of use of CHP Electrical Generation Plant	90%	
Fraction of heat available for sale from CHP	40%	
Efficiency of CNG gas scrubbing and compression	98%	
Overall Methane Fraction of Biogas	60%	
Efficiency of electrical energy to heat	60%	
Litres pf Petrol Equivalent to 1kg Methane	1.64	l/kg.CH4
Energy consumption for operation of pumps and pl	Nominal	Costs in Overheads, adjust CER req.
CARBON DATA		
Carbon cycle	10	*years*
Carbon credit price post 2010	7	*€/CER*
SA emissions factor	1.0	*kg CO2/kWh*
Carbon project development price	1.2	*Rm*
CDM Verification costs (annual)	30000	*R*

Model – WW inputs

Calculation methodology:	COD data	*select from drop-down list*	
Insert daily waste water flow rate	0	*ML/day (MegaLitres/day)*	
Insert the COD of the waste water stream	450	*mg/litre*	*200 - 1000*
Indicate the COD removal as a percentage	80%	*%*	*80% is typical*
Will the supernatant from the digester return to a sewer?	Yes		
If No, will the supernatant be treated with a package plant?	Yes		
If No, will the supernatant be treated with a reedbed system?	Yes		
If No, will the supernatant be treated with an algae system?	Yes	*Only 1 answer here to be Yes*	

Calculation methodology: COD destroyed

0	*tons COD removed/day*	
0.00	*t CH4/day*	
0	*MWh/day (total)*	
0	*MWh/day (elec)*	*30% efficiency*
0	*MWh/day (thermal)*	*50%*
0	*kWelec*	

GO BACK TO INPUTS

Model – outputs

			2009
Investment in biogas digester	R	R	-177,871,370
Installation fees	R	R	-100,000
Eskom grid connection fee	R	R	-
Power purchase	R	R	-
Management fee		R	-
CDM charges	R	R	-
Electricity saving	R	R	-
Electricity saved p.a.	kWh		37,271,950
Electricty cost	R/kWh		0.385
CER revenue	R	R	-
Number of CER credits	tons		-
Maintenance / insurance costs	R	R	-
REFiT			
Revenue	R	R	-
Cash flow	R	R	-177,971,370
Interest charges		R	-
Total cash flow	R	R	-177,971,370
Discounted cash flow	R	R	-177,971,370
			1.0
			1.0

Results	IRR		16.75%
NPV	R	R	63,479,530
Simple payback period	Years		8.22
Discounted payback period	Years		13.80
Electricity saved	MWh p.a		37,272
	MW		

Policy, recommendations

- Overarching legislation
  - Municipal Systems Act
  - Municipal Finance Management Act
- Energy legislation
  - White Paper on RE
  - DME
  - NERSA
- Water
  - DWAF
  - National Water Act
  - Water Services Act
  - Aide Memoire
- Solid waste
  - Integrated Pollution & Waste Management Policy for SA
  - National Waste Management Strategy
  - General waste management legislation
  - Polokwane Declaration on Waste Management in SA
- Recommendations??

Thank you!

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