

# Green economy via Decentralised Energy generation and Waste Management by a 60kg/day Kitchen Waste Biogas Plant at Postal Training Centre, Mysore, India

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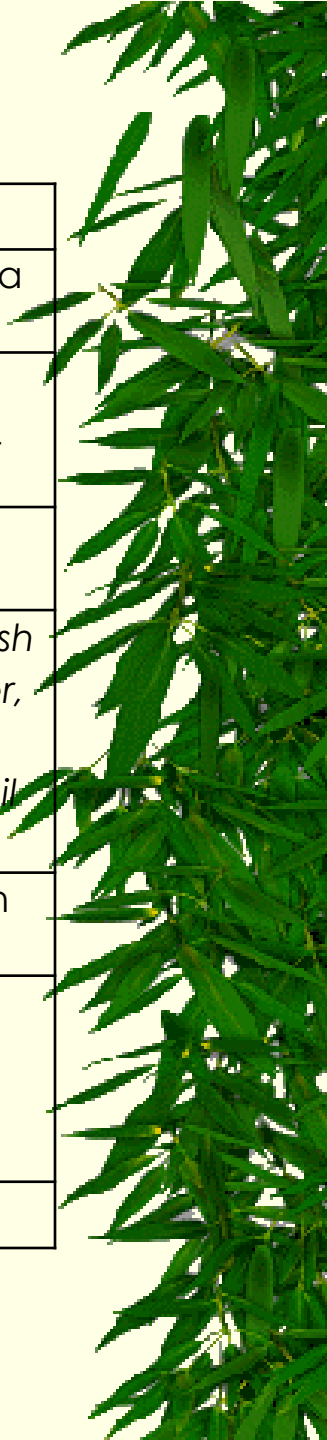


# ABBREVIATIONS/KEYWORDS

Abbreviation	Expansion	Brief Introduction
NIE	National Institute of Engineering, Mysore	Renowned Engg. College in Karnataka (estd:1946)
NIE-CREST	NIE-Centre for Renewable Energy (RE) & Sustainable Technologies (ST)	Centre of excellence at NIE for promotion & dissemination of RE & ST
PTC	Postal Training Centre, Mysore	Gol organisation for postal training
KW	Kitchen Waste	Waste from Kitchen i.e <i>Rice starch, wash water of rice, used tea/coffee powder, waste atta, leftout rice, sambar, vegetable/fruit waste, waste edible oil and other cooked waste</i>
KWBP	Kitchen Waste Biogas Plant	Biogas plant which transforms kitchen waste to biogas
BOD	Biochemical Oxygen Demand	Pollution level indicative parameters
COD	Chemical Oxygen Demand	
CO <sub>2</sub>	Carbon Dioxide	Common green house gas

5/28/2015

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& Head ,NIE-CREST, NIE, Mysore.



# BIOGAS PLANT OF CAPACITY 60KG/DAY AT PTC, MYSORE



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# KITCHEN WASTE: A MENACE AT PTC



- **Postal Training Centre [PTC], Mysore** (*former Mysore palace*)– Govt Organisation for training on postal services.
- **Kitchen Waste** dumped in open space – an pollution issue in the campus
- **Problems :-** Pigs, foul odour, nuisance, unhygienic conditions and many problems

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# RESEARCH OBJECTIVES

- ✓ **To study the aspect of**
  - Waste Management
  - Quality of biogas generated
  - Monetary savings/annum from the biogas plant in terms of savings in LPG
  - Reduction in COD and BOD of the effluent
- ✓ **To estimate the reduction in the CO<sub>2</sub> emission**
- ✓ **To observe & quantify**
  - *performance of biogas plant & note benefits accrued to PTC after installation of biogas plant.*





# DETAILS OF WASTE GENERATION AT PTC, NAZARABAD, MYSORE

Sl No.	Date	K W gen. (kg/day)	V/F W gen. (kg/day)	Total (kg/day)
1	22.01.2013	41	13	54
2	23.01.2013	30	13	43
3	24.01.2013	15	12	27
4	25.01.2013	20	10	30
5	26.01.2013	24	12	37
6	27.01.2013	20	10	30
7	28.01.2013	27	15	42
8	29.01.2013	28	5	33
9	30.01.2013	18	8	26
10	31.01.2013	21	18	39

Source: Office of the Director, PTC, Mysore, 15th February 2013

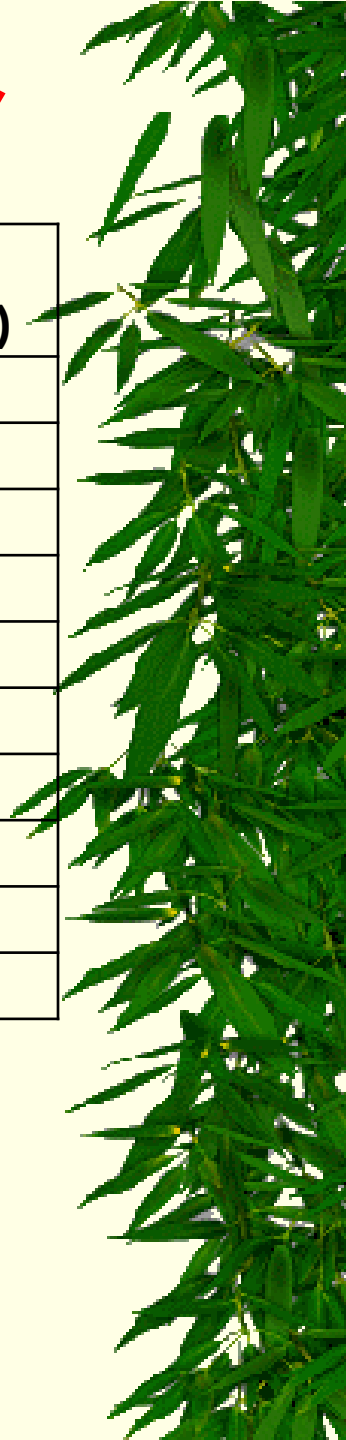
## Legend

**K W gen.** → Kitchen Waste Generated per day

**V/F W gen.** → Vegetable/fruit waste generated per day

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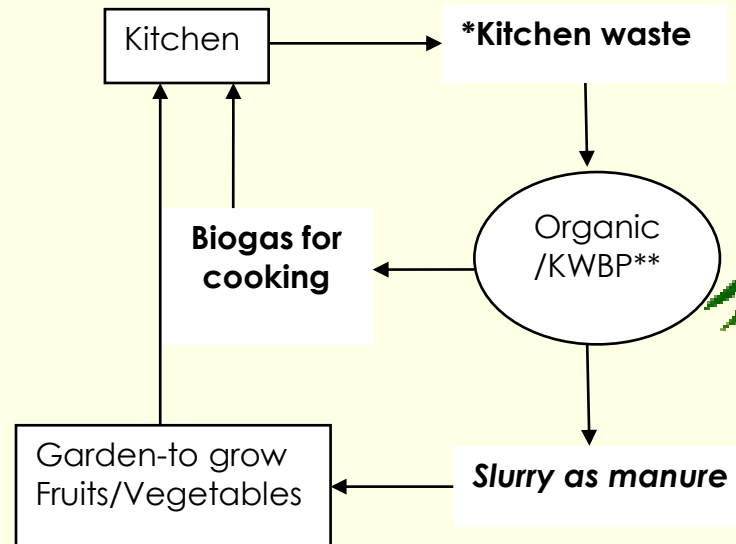
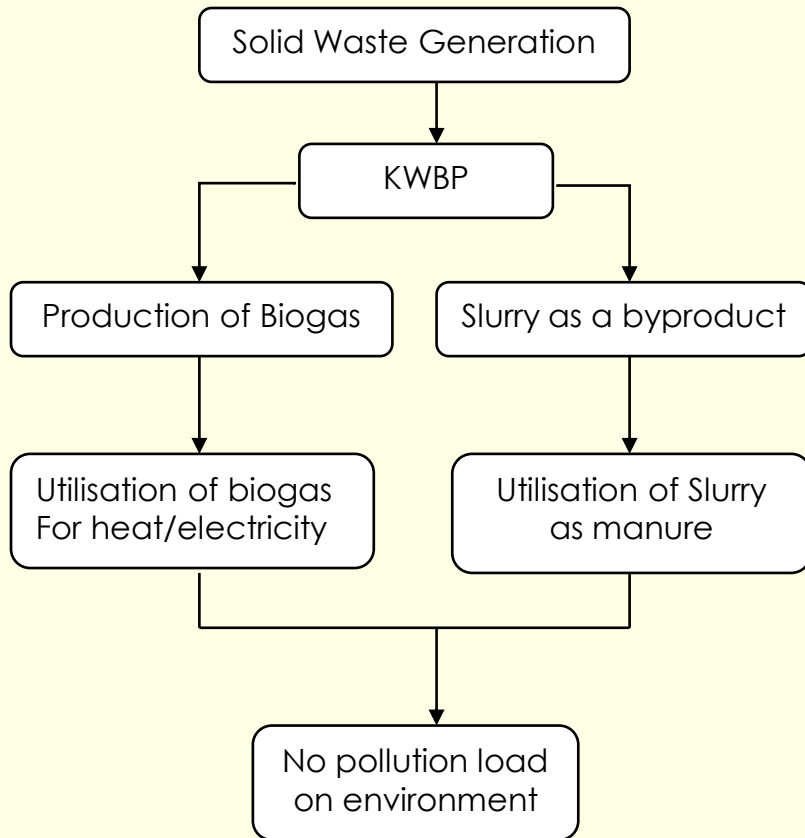
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# SOLUTION PROPOSED BY NIE-CREST

## \*60kg/ day Kitchen Waste Biogas Plant

*Biogas plant = Waste Management + Energy Generation*



# METHODS

- **Quantitative analysis** of waste fed to the plant for 2 months
- **Gas Chromatography** to determine the composition of biogas
- **Monetary Benefit estimate**- money saved from Biogas generated calculated by finding its equivalent of LPG
- **Estimate of reduction in CO<sub>2</sub> emission**
- **COD, BOD Analyses:** COD at inlet (kitchen waste) - output(Slurry) to find the reduction in COD
- **Nutrient (Nitrates Phosphates & Sulphates) analyses** - output slurry analyzed for nutrients to explore possibilities of utilizing slurry as organic manure without any treatment





# DATA ANALYSIS

**Table 1** Composition of biogas obtained from Gas Chromatography

Sl No.	Constituent	%
1	Methane	49
2	Carbon di-oxide	45
3	Traces [H <sub>2</sub> S, NH <sub>3</sub> , H <sub>2</sub> O, N, H and O]	6

**Table 3:** Cumulative data of 60days ( from 1<sup>st</sup> Sep to 31<sup>st</sup> Oct 14)

Total quantity of waste fed in 60 days	2600kg
Total quantity of biogas generated in 60days	251.65m <sup>3</sup>

**Table 5:** Analysis of Outlet Slurry for nutrients

Parameter	Concentration (mg/L)
Nitrate	10.5
Phosphate	39.5
Sulphates	10.0

**Table 2** Sample Data of waste fed, biogas generated at PTC, Mysore in the month of Oct 2014

Date	Waste fed (kg)	Biogas Generated (m <sup>3</sup> )
01/10/2014	52	5.54
03/10/2014	50	8.99
04/10/2014	60	5.29
05/10/2014	55	4.56

**Table 4:** Data of COD & BOD content in waste before and after biogas generation

Parameter	I/L ( KW) (mg/L)	O/L slurry (mg/L)	Red.n (mg/L)	% Red.n
COD	73600	18600	56000	74.72
BOD	30600	5850	24750	80.88

**Table 6** Economics-Investment, savings and payback period

Investment	INR 4.35 Lakh
Total savings through LPG Per annum=611.94kgX Rs.97.68/kg	INR 0.60 Lakh
Recurring Expenditure per year (for maintenance/repair) of accessories like crusher and blower:	INR 0.10 Lakh
Net Savings per annum	INR 0.50 Lakh
Pay back period (4.35/0.5)	8.7 Years

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August 2014.

50Kg/day

Input

Prefabricated

Biogas plant

at Chamundi

Hill, Mysore .

Ready to

Install.

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# Prefabricated- Mild Steel Kitchen Waste Biogas plant of capacity 100kg per day at BIT, Davangere



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PREFABRICATED BIOGAS PLANT (1 to 5kg per day)  
– MS material



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## Kitchen waste biogas Plant at my Home, ..... Mysore, India



Nov 2013- working since 2008.

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# Kitchen waste biogas Plant at my Home, ..... Mysore, India- 2012



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## Promotion of Biogas Plants for Houses



**1500 kg/day Input biogas plant at Mysore Zoo built by NIE-CREST- cost 25 lakh Rupees ( 40000 us dollars)**



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<b>Input to the plant</b>	<b>1-10 kg of kitchen waste + water mixture per day.</b>	
<b>Area required</b>	4m <sup>2</sup>	
<b>System Elements</b>	Plastic drums (of Capacity 1000L and 750L), Gas flow pipe line, Moisture trap systems, Biogas Burner	
<b>Type of feed</b>	<i>Kitchen waste like rice starch, wash water of rice ,used tea powder, coffee powder, waste atta, left out rice, sambar, over ripened fruits, vegetable waste, waste edible oil and other cooked waste from kitchen</i>	
<b>Application</b>	Bio gas for cooking at Kitchen Slurry as manure for gardening	
<b>Daily biogas and manure</b>	Generation of biogas per day (Max.)	0.65m <sup>3</sup>
	LPG Equivalent of biogas per day	0.26 kg
	Savings through LPG per day	Rs.25.40
	Savings through manure per day	Rs.1.20
	<b>Total returns per day through biogas and manure</b>	<b>Rs.26.60</b>
<b>Monthly biogas and manure</b>	Generation of biogas per month	19.50 m <sup>3</sup>
	LPG Equivalent of biogas per month	7.80kg
	Savings through LPG per month	Rs.761.90
	Savings through manure per month	Rs.36
	<b>Total returns per month through biogas and manure</b>	<b>Rs.797.90</b>
<b>Annual biogas and manure</b>	Generation of biogas per year	237.25 m <sup>3</sup>
	LPG Equivalent of biogas per year	97.90 kg (5Cylinders) →(5)
	Savings through LPG per year	Rs.9269.83
	Generation of Manure per year	146 Kg
	Minimum cost of manure per kg	Rs.3/-
	Savings through manure per year	Rs.438
	<b>Total returns per year through biogas and manure</b>	<b>Rs.9707.83</b>
<b>Investment</b>	<b>Approx. Budget for implementation</b>	
	Basic Model	Rs.25,000
	<b>Model 2</b>	<b>Rs.30000</b>

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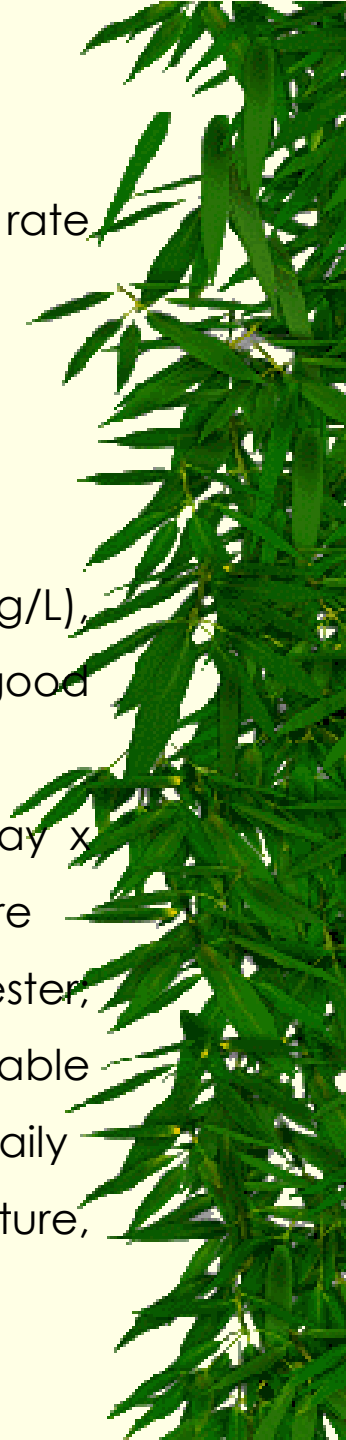
# RESULTS AND DISCUSSION:

Biogas plant has benefited PTC in following ways

- **LPG Savings**-already accomplished savings of 100.66kg of LPG, at same rate, it can lead to **611.74kg of LPG** per year
- **COD Reduction=74.72%**
- Payback period is **8.7 years**
- **Reduction in CO<sub>2</sub> emission = 1.85tonne per year**
- **Organic manure**:- Presence of nutrients- Nitrates (10.5mg/L), Phosphates(39.5mg/L) & Sulphates (10mg/L) in output slurry makes it a good organic manure
- At a feed rate of 43.33kg per day, biogas plant converts 43.33kg/day x 365days = 15815.45kg (15.82tonnes) of waste to energy & organic manure
- Methane leakage is prevented by water jacket around the main digester, working pressure << atmospheric pressure (200millibars), no unavoidable leakage due to excess volume either as biogas is being utilized by PTC daily
- Maintenance of Biogas plant will be handed over to PTC in near future, meanwhile PTC will be trained well enough to be qualified for O&M

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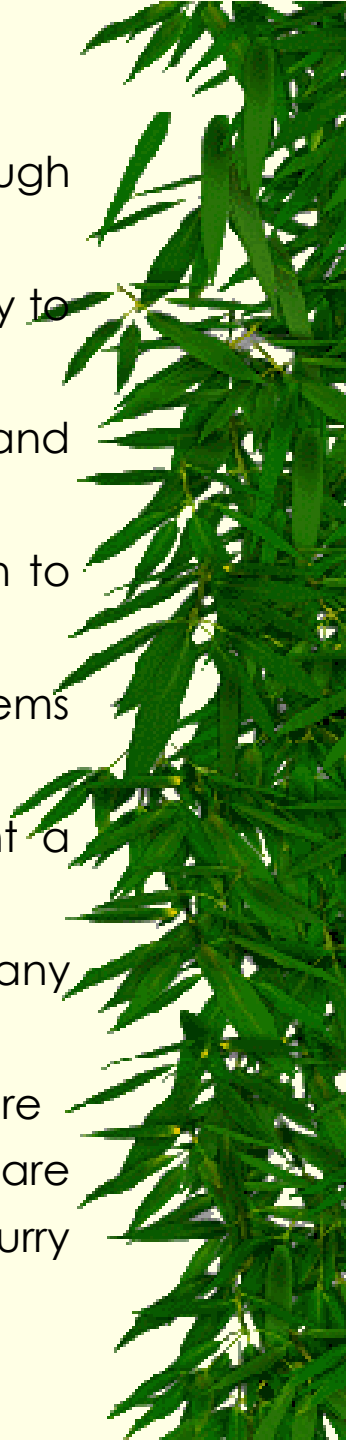


# CONCLUSIONS

- Although the payback period is 8.7 years, the savings through environmental conservation is intangible.
- Cost of conventional LPG Cylinders and generation of Solid Waste is likely to increase in future;
- Savings through reduction in carbon dioxide emission/Carbon foot print and price escalation of LPG have not been considered.
- Payback period will be less than 8.7years if both the issues are taken in to account
- This enables biogas plant to create decentralized microenergy systems sustainable green economy
- Reduction in BOD, COD through biomethanation makes biogas plant a feasible option for treatment of biodegradable waste
- Biogas plant acts as a model for solid waste management for many institutes.
- Slurry from outlet has a good nutrient value for using it as a organic manure
- In contrast to conventional solid waste management methods which are energy intensive, biogas systems generate waste from energy & yield slurry as manure

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# CONCLUSIONS Contd.

- ✓ This makes it possible to achieve zero discharge
- ✓ Adapting these systems in any campus will make the campus compatible for ISO 14001;2004
- ✓ India being a tropical country has lot of scope for establishing biogas plants to solve problems of energy crisis & waste management in a single system.
- ✓ biogas plants can be implemented at any place as they are decentralized micro energy systems which create green economy.
- ✓ Technology can be presented as a business model .
- ✓ biogas plants of smaller capacities (1 to 5kg/day, 6 to 10kg per day) for households have been fabricated by us out of Locally available PVC Water tanks instead of masonry/concrete construction and 100 such plants have been built.





***THANK YOU***

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