Biomass Power Plant market in India

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Vishal looks at the biomass power plant options in India and studies the financial details for each option.

Even today in 2013; over 400 million people in India have no access to electricity. Because of the remoteness of much of India's un-electrified population, renewable energy can offer an economically viable means of undoing this undone. And what better than a biomass power plant.

Today, about 32% of the total primary energy use in the country is still derived from biomass and more than 70% of the country's population depends upon it for its energy needs in some way or the other. Biomass power generation in India is an industry that attracts investments of over Rs.600 crores every year, generating more than 5000 million units of electricity and yearly employment of more than 10 million man-days in the rural areas.

We can divide the biomass power plant market in India into 3 categories.

Biogas based power projects

Present:

- The current availability of biomass in India is estimated to be approximately 640 million metric tones per annum. This converted to cubic meters of biogas comes to 12800 million cubic meters per annum (@ 20 cubic meters of biogas per metric ton of biomass).
- This should lead to both electricity and heat generation of 25600 GWh and 51200 GWh per annum respectively (@ 2 KWh of electricity and 4 KWh of heat energy per cubic meter of biogas).
- The Government of India has estimated this availability of biomass to a corresponding potential of about 18000 MW generation capacity.
- If the above two statements are combined, it comes to around 4 hrs of electricity generation for 365 days a year. Some case studies displayed at MNRE website talk about 6-7 hours of electricity daily in villages using a 10 KW plant.
- A total of around 130 biogas power projects have been installed in the country as on date for feeding power to the grid aggregating to 1176.10 MW of generation capacity.

Potential:

- The current potential of biomass in India including the below mentioned figures is estimated to be approximately 1200 million metric tones per annum.
  a. Agricultural and forestry residues (amounting to 120 – 150 million metric tones per annum),
  b. Residues from approximately 304 million cattle waste (amounting to 950 – 1000 million metric tones per annum), and
  c. Residues from 649 million birds' waste courtesy poultry farms (amounting to 100 – 125 million metric tones per annum).
- This converted to cubic meters of biogas comes to 24000 million cubic meters of biogas per annum (@ 20 cubic meters of biogas per metric ton of biomass).
- This should lead to both electricity and heat generation of 48000 GWh and 96000 GWh per annum respectively (@ 2 KWh of electricity and 4 KWh of heat

Description	Specification	Remarks	Other Remarks
Plant Capacity	100 KW	Pure gas based plant	
Capital Cost	INR 29.06 lakhs	Approximate	The capital cost includes all equipment, building and project development. It does not include the costs of land and grid connection, if any.
Capital Subsidy	a) INR 4.52 lakhs	a) INR 20 lakhs x (MW capacity)^0.646	a) For all states except NE region, Sikkim, J&K, HP and Uttaranchal
	b) INR 5.65 lakhs	b) INR 25 lakhs x (MW capacity)^0.646	b) For special category states viz. NE region, Sikkim, J&K, HP and Uttaranchal
Capital Cost (after subsidy)	INR 24.54 lakhs	Considering only case (a)	Additionally, fiscal incentives such as 80% accelerated depreciation, concessional import duty, excise duty, tax holiday for 10 years, etc. are also available
Equity	INR 17.178 lakhs	70%	
Loan	INR 7.362 lakhs	30%	- Interest Rate – 13% (Why?) - Repayment Period – 10 years
EMI	a) INR 10992.00		
Average Load	80 KW		
Number of electricity units	384 MWh per annum	Assumed for 16 hours a day & 300 days a year	
Savings in **- Diesel (Liters)**	90264 liters	@ 0.236 liter/KWh	
- Diesel (INR)	INR 4.51 million	@ INR 50 / liter	
- O&M cost of DG set	INR 384000.00	@ Re 1 / KWh / annum	
- CO_2 emission	267.40 tones of CO2 equivalent	@ 73.3 kg of CO2/GJ of diesel consumption	Assuming a heat rate of 9500 KJ/KWh for diesel
Cost per unit **- DG Set**	INR 12.75 / unit	Costs considered include: - Cost of Biomass – INR 1100/ton - O&M – INR 1.92 lakhs per annum	
- Biogas plant	INR 2.50 / unit	EMI	Biomass required is assumed to be 120 kg/hr

Table 1.

energy per cubic meter of biogas).

- So, if we analyze, we are underutilizing this form of bio energy by 560 million metric tones of biomass per annum, 11200 million cubic meters of biogas per annum, 22400 GWh of electricity per annum and 44800 GWh of heat energy per annum. That's quite some number.
- The GOI keeps talking of under recovery with respect to crude oil based products and their pricing. What about bio energy? Food for thought, isn't it?

Finances:

- In most of the Indian villages, DG sets are often the only source of power but power from biomass gasifier based plants is considerably cheaper where ever biomass is available. Even for dual fuel operation where 20 % diesel is used, the generation costs are lower, especially with high running hours and loads. The savings are dramatic when pure gas engines are used.
- Even when grid power is available, the actual cost of power at the point of consumption is very high largely due to line losses in transmission and distribution with government subsidies and financial losses of DISCOM's taking the brunt.
- The tariff fixed by commissions of different states ranges between INR 2.80 to 5.14 /KWh.
- Let's look at a typical example of a 100 KW biogas power plant (table 1).

Bagasse based co-generation projects

Present:

- Currently, there are approximately 500 operational sugar mills in India.
- These mills receive on an average 225 million tones of sugarcane every year for crushing out of the 325 million tones produced i.e. approximately 70% (production figure achieved by taking an average of sugarcane production from 2006 to 2011).
- This produces around 75 million tones of wet bagasse (50% moisture) per annum (@ 0.33 tones of wet bagasse per tone of sugarcane).
- Considering an LCV of 7000 KJ/kg for wet bagasse with 50% moisture content, the total energy content is 525 million GJ per annum.
- This should lead to electricity generation of 7500 GWh per annum (@ 100 KWh of electricity per ton of wet bagasse with 50% moisture). However, new age co-generation plants are being considered to generate up to 200 – 300 KWh per ton of wet bagasse with 50% moisture.
- A total of around 211 bagasse based co-generation projects have been installed in the country as on date in sugar mills with surplus capacity for feeding power to the grid aggregating to 3221.41 MW during season and 732.00 MW during off-season.
- A total of around 211 bagasse based co-generation projects have been installed in the country's sugar mills as on date for feeding power to the grid aggregating to a surplus capac-

Description	Specification	Remarks	Other Remarks
Plant Capacity	10 MW		
Capital Cost	INR 47.50 crores	Approximate	
Capital Subsidy	a) INR 66.39 lakhs	a) INR 15 lakhs x (MW capacity)^0.646	a) For all states except NE region, Sikkim, J&K, HP and Uttaranchal (Private Sugar Mills)
	b) INR 79.67 lakhs	b) INR 18 lakhs x (MW capacity)^0.646	For special category states viz. NE region, Sikkim, J&K, HP and Uttaranchal (Private Sugar Mills)
	c) INR 2.12 – 3.18 crores	c) 40 lakhs to 60 lakhs x (Per MW of surplus power)	For co-operative / public sector sugar mills
Capital Cost (after subsidy)	a) INR 46.84 crores	Considering only case (a)	Additionally, fiscal incentives such as 80% accelerated depreciation, concessional import duty, excise duty, tax holiday for 10 years, etc. are also available
Equity	a) INR 32.79 crores	70%	
Loan	a) INR 14.05 crores	30%	- Interest Rate – 8% - Repayment Period – 10 years
EMI	a) INR 17.05 lakhs		
Captive Consumption, MW	Season – 4.70 MW Off season – 1.68 MW	- Season - 20304 MWh - Off season – 5645 MWh	- 320 days of operation (180 season days and 140 off season days), 24 hrs a day
Exportable surplus capacity, MW	Season – 5.30 MW Off season – 18.32 MW	- Season - 22896 MWh - Off season – 61555 MWh	- 320 days of operation (180 season days and 140 off season days), 24 hrs a day
Savings in CO_2 emission	110400 tones of CO2 equivalent	@ 1 kg of CO_2 e/KWh	

Table 2.

ity of 3221.41 MW during season and 732.00 MW during off-season.

Potential:

- A typical sugar mill consumes around 31 KWh of energy/day/ton of sugarcane crushed and produces around 66 KWh of power/day/ton of sugarcane crushed through its cogeneration plant.
- Therefore, a typical sugar mill supplies around 35 KWh of power/day/ton of sugarcane crushed of net power to the grid.
- For a sugar mill of 3500 ton of sugarcane crushing per day, the net power supplied to the grid will equal to 122.5 MWh per day. The yearly figure will depend on the seasonal and non-seasonal number of months.
- A 10 MW bagasse based cogeneration power plant should be sufficient to produce 66 KWh of electricity/day/ton of sugarcane crushed.
- Considering that all the sugar mills in India have cogeneration plants and a consumption and generation pattern as above, the total bagasse based cogeneration potential in India has a potential in excess of 3500 MW capacity.
- The Government of India has estimated a potential of 5000 to 5575 MW provided the sugar mills were to adopt technically and economically optimal levels of cogeneration for extracting power from the bagasse produced by them.

Finances:

- Bagasse based Cogeneration allows not only self-sufficiency to a sugar mill but also an increase in the electricity generation capacity of the country.
- The tariff fixed by commissions of different states ranges between INR 3.12 to 4.79 /KWh.
- Let's look at a typical example of a 10 MW bagasse based cogeneration power plant (table 2).

Waste to Power (Urban) projects

Approximately, 50000 million tones of solid waste and 2500 million cubic meters of liquid waste are generated every year in the urban areas of the country which can be suitably recycled for power generation. This is expected to increase at a per capita rate of approximately 1 to 1.33% annually. By 2025, it is assumed that the urban municipal weight would double the current levels. Waste to power is one answer to this growing problem.

A total of 89.68 MW of electricity generation capacity is installed in India as on date from waste to power (urban) projects. Experts forecast a potential of 1700 – 2500 MW with the recycling of this urban, municipal and industrial waste in large cities and metros which indicates that India has so far realized only about 3 - 4% of its urban waste to energy potential. The capital cost to create this kind of generation capacity is estimated to be under INR 300 crores, resources for which could be generated through municipalities and local governments in metros and large townships with subsidy element coming towards such projects from state governments concern.

This form of energy is, therefore, not only important from the energy security point of view but also from the waste management and disposal point of view.

Conclusion

As per ex President of India Dr APJ Abdul Kalam, our country has a huge potential of tapping energy from biomass, and rightly so. Both Biogas and bagasse based Cogeneration power plants have a payback period of 7 – 12 years with REC, Carbon credits and CDM mechanisms which may help to further reduce it. So, what is stopping us to promote, propagate, produce and purchase bio energy to its 100% potential? Do we require a Katrina Kaif to endorse bio energy too to realize its importance? If yes, then why not. But then, who will bell the Kat?

Disclosure: The data and information used at various junctures in the above article are approximate and accuracy of these is not guaranteed. It is as per the data available on various forums online and in books.

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