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BIOENERGY INDIA

A Quarterly Magazine on Biomass Energy, Published under the UNDP-GEF Biomass Power Project of Ministry of New and Renewable Energy (MNRE), Government of India. Produced by Winrock International India (WII)

In Focus

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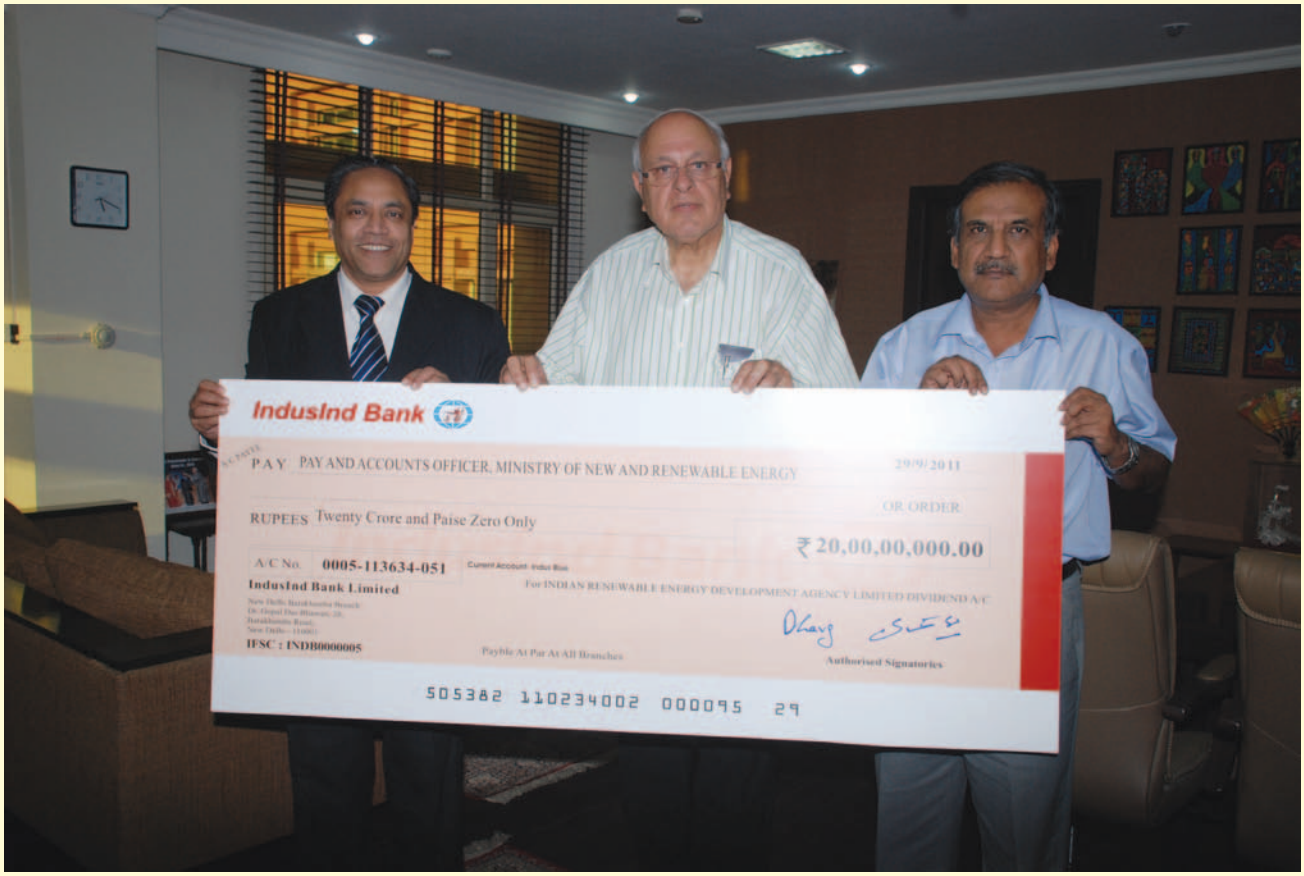
- Crop Residue Management: Establishing Efficient Systems and Equipments

Press Release



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IREDA presented a cheque of ₹ 20.00 crore (Rupees Twenty Crores only) towards dividend for the financial year 2010-11. The dividend payment to the Government of India by IREDA has increased over 37% as compared to the last year. The dividend cheque was presented by Shri Debashish Majumdar, Chairman and Managing Director, IREDA to Dr. Farooq Abdullah, Hon'ble Union Minister, New and Renewable Energy in the presence of Shri Deepak Gupta, Former Secretary, MNRE in a function held in New Delhi on Friday, the 30th September, 2011.

During the year 2010-11, IREDA registered creditable success and excellence in all facets of its activities. IREDA posted a robust all-round performance with an all-time high Profit Before Tax (PBT) of ₹ 166.70 crore registering a 18.19% rise over the previous fiscal, and has recorded its highest ever Profit After Tax (PAT) of ₹ 120.46 crore as compared to ₹ 72.69 crores over the previous fiscal.

Loan sanctions and disbursements during the year stood at ₹ 3126.42 crore and ₹ 1224.17 crore respectively, which is an increase of 71.41% in sanctions and 37.54% in the disbursement as compared to the last year.

BIOENERGY INDIA

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FROM THE EDITOR

Dear Readers,

We are optimistic that Bioenergy India has created a niche of its own among the technocrats, entrepreneurs, policy makers, biomass developers, user communities who are involved in the development and management of biomass energy in the country. An important event took place on 27th September 2011 in New Delhi, when the Ministry of New and Renewable Energy (MNRE) organized a day long conference on 'Biomass Power – Potential, Issues and Challenges'. It was attended by entrepreneurs, technocrats and policy makers where experiences were exchanged and future challenges were discussed. A brief report has been presented in this issue. The Ministry has conceived a Biomass Road Map during the 12th Five Year Plan Period, which was uploaded on the Ministry's website for comments. Salient features of the Road Map along with comments from various stakeholders are featured in this issue. These, we are sure, will play an important role in future policy making exercises.

The first Model Investment Project under the UNDP/GEF Biomass Power Project has been commissioned in Gujarat. The 1.2 MW grid connected biomass gasifier project has many innovative features and a detailed report about this project has been included in this issue. Biomass fuels are predominantly used in rural households for cooking and water heating. A few private business initiatives as well as development organizations are working to develop improved cook stoves for the rural household. Two interesting articles narrate the success of co-creation as a marketing tool for developing energy efficient stoves and narrate experience of cook stove project registered under CDM. India has a long history of energy planning and programme interventions. The articles 'Powering the Biomass Resource for Power Generation in India' and 'Biomass Power Generation Potential, Incentive and Tariff – A Snap shot' have explored the technical, as well as, the current economical aspects of power generation, using biomass resources in India.

Besides, we have offered articles that encompass wide ranging issues that include snippets on efficient harvesting machines; exploring potential and sustainability of biomass based green technologies to keep you abreast with the current situation on the bioenergy front. This issue has also presented experiences of several private business entities, which, we are sure, will enrich our knowledge on different bioenergy issues in a more lucid way.

Last, but not the least, we want this magazine to be an interactive one and want our readers to voice their comments and suggestions to us. We will also welcome unique insights on different biomass energy issues by our readers.

Wish You a Very Happy & Prosperous New Year.

VK Jain

(VK Jain)

BIOENERGY India is a quarterly magazine covering technological, operational, financial and regulatory aspects of various biomass conversion technologies such as combustion, cogeneration, gasification and biomethanation. Biomass specific project perspectives, technology innovations, industry/market outlook, financial schemes, policy features, best practices and successful case studies etc., are also included in the publication.

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In Focus

Bioenergy Road Map – An Initiative by MNRE

Nearly 70% of India's population lives in villages and agriculture are the main source of livelihood. Approximately 300 million household don't have access to the commercial energy-electricity and cooking gas.

To address the demand of electricity in the remote villages Government of India has launched an ambitious program of providing electricity supply to villages by 2012 and making available at least 1 kWh/household/day. Significant progress has been made so far in development of technology and establishing different business models for conversion of surplus agro-residues to supply power and heat for commercial activities including export of power to the grid.

While launching India's National Action Plan on Climate Change on June 30, 2008, the Prime Minister of India, Dr. Manmohan Singh stated: "Our vision is to make India's economic development energy-efficient. Over a period of time, we must pioneer a graduated shift from economic activity based on fossil fuels to one based on non-fossil fuels and from reliance on non-renewable and depleting sources of energy to renewable sources of energy".

Taking cue of Prime Minister's view, MNRE has planned to initiate the "National Bioenergy Mission" in association with State Governments, Public & Private sectors and other stake holders to promote ecologically sustainable development of Bioenergy to address country's energy security challenge. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change. Biomass energy system has some unique characteristics making it the most attractive renewable option for the rural areas which include largest potential for improving rural energy access, generating additional rural energy income, environmental impact, low cost etc.

To develop a road map for rapid development of commercial biomass energy market based on the utilization of surplus agro-residues and development of energy plantation in India, MNRE has appointed M/s Dalkia Energy Services for carrying out the required studies and research.

After completing a number of studies, M/s Dalkia Energy Services has submitted a report to MNRE for further approval. A brief snap shot of the report is given below:

Objectives

The objectives of the biomass road map are as follows:

i) To significantly increase the share of biomass power in the energy basket of India by creating the policy conditions for its diffusion across the country as quickly as possible.

ii) There will be a two phase approach of this road map, spanning the 12th Plan (2012-17) as Phase 1, and the 13th Plan (2017-22) as Phase II. In phase I, focus will be on policy and regulatory interventions for improving sustainability of grid connected biomass IPPs. A wider consultation would be carried out with State Governments and other stakeholders for development of a national policy on utilization of waste land for energy plantation. In the subsequent phases, after taking into account the experience of the initial years, capacity will be aggressively ramped up to create conditions for up scaled and competitive biomass energy penetration in the country.

According to the report, to achieve the above objectives, the immediate targets are:

Targets

i) To create an enabling policy framework for the deployment of 20,000 MW of biomass power by 2022.

ii) To ramp up capacity of grid-connected biomass IPP by 5697 MW by 2017; an additional 13050 MW by 2022 out of which, plantation target would be 800 MW in 2017 and another 3000 MW by 2022 through the mandatory use of the renewable purchase obligation by utilities backed with appropriate tariff and generation based policy incentives.

ii) To develop tail end grid connected DG projects of sub-2MW capacity each- 700 MW by 2017 and another 3000 MW by 2017 by creating enabling environment, which would include development of commercial technologies for grid compatibility and island mode operation of such projects, incubation of rural energy services companies including integrated franchisee' model and financing schemes for them and subsidy through generation based incentive mechanism.

iii) To promote off-grid schemes with aggregate capacity addition (including for equivalent fuel production) of 225 MW by 2017 and another 350 MW by 2022 by supporting development of and incubating Rural Energy Supply Companies and Rural Fuel Supply Companies.

iv) To develop captive and cogeneration projects in the SME industry segments based on gasification, combustion, and waste heat recovery and bio-methanation technologies. Target for these segments would be 425 MW by 2017 and another 600 MW by 2022.

v) The ambitious target for 2022 of 20,000 MW or more, will be dependent on the "learning" of the first phase, which if successful, could lead to conditions of development of grid-competitive biomass power. During the 1st phase, it is proposed to carry out several R&D and pilot demonstration projects.

Overall Target 2017

Biomass	IPP	Tail End	Off Grid	Cogen	Purified Gas	Thermal/Cooking Purposes	Refrigeration	Total
Agro Residue / Waste	2100	550	150	800	-	-	-	3600
Plantation	800	150	75	200	-	-	-	1225
Urban/Industrial Wastes	300	50	350	-	-	-	-	700
Wastes from Dispersed Systems	-	-	50	-	45	42	35	172
Total	**3200**	**750**	**625**	**1000**	**45**	**42**	**35**	**5697**

Overall Target 2022

Biomass	IPP	Tail End	Off Grid	Cogen	Purified Gas	Thermal/Cooking Purposes	Refrigeration	Total
Agro Residue / Waste	3000	2000	250	1500	-	-	-	6750
Plantation	3000	1000	100	500	-	-	-	4600
Urban/Industrial Wastes	750	125	500	-	-	-	-	1375
Wastes from Dispersed Systems	-	-	95	-	85	80	65	325
Total	6750	3125	945	2000	85	80	65	13050

The Biomass Road Map document is uploaded in the website for comments and suggestions from different stakeholders. The comments and the suggestions received till date by MNRE are as follows:

Comments/Suggestions on Biomass Road Map by Bioenergy Companies

Zoning

A biomass power plant, in order to succeed, should not be put under intense competition. If two developers compete for the same quantum of biomass available in the region, the biomass prices tend to increase affecting the viability of both the projects. Hence, it is suggested that, there should be a regulation that only one project is allowed in a district or there should be a radial distance of minimum 75 km between two plants. This way the escalation in biomass prices can be contained to some extent.

Sizing of the project

The installed capacity also plays an important role in the success of a biomass project. As it is known that each MW requires approximately 30 tones of biomass a day, unless there is a restriction on the size, it is possible that handling becomes a difficult task. Hence, MNRE may think in terms of putting a restriction on the size up to 7.5MW so that it becomes more convenient to procure as well as handle the biomass.

1 to 2 MW tail end biomass power plants should be encouraged and given more subsidies over bigger plants.

Tail and co-generation plants should be given more subsidies in comparison to tail end IPP to reduce biomass transportation cost as well as to achieve better SHR , this will enable the country to develop infrastructure of cold storages to preserve perishable farm produce in the proximity of farms.

The Government of India (GOI) is developing 20,000 MW solar power infrastructure which will be available in day time, so biomass road map should consider biomass power plants which can be operated to cater increase demand of evening peak as the wind power cannot be scheduled. This will give Government flexibility in generation of power, the big pithead plants will be operating at base load & small tail end plants will be operating in day peak & evening peak hours.

State Level Requirements/Approvals, Issues with Power Utilities and Regulatory Authorities

MNRE could set a clear time scale for the basic approval of the project. As of today, an additional approval has to be taken from the State Nodal Agency which is really superfluous. If MNRE approval could be considered adequate by concerned State Agencies (Pollution Control Board, Electricity Authorities etc.), one additional process could be eliminated. If this is not possible, it should be ensured by MNRE that the State Nodal Agency issues the necessary approval within seven days of MNRE approval.

The projects should be bracketed in Green Category by the pollution control board and should be considered

eligible for automatic approval based on clear undertakings from the project promoters to adhere to the relevant pollution control guidelines which should be clearly defined. Gujarat currently has two levels of approvals - approval to establish and approval to operate which are quite time consuming.

Most State Power Utilities are now split into a number of organizations - Distribution Companies, Transmission Companies, and Generation Companies etc. Given that these projects are typically connected at 11 KV level, **the concerned Discom should be made a single window clearance agency and the procedures should be standard and straight-forward.**

Some Regulatory Agencies are mandating scheduling and availability based tariffs with provision of ABT meters etc. These requirements are difficult to meet with small projects connected to 11 KV grid and need to be eliminated as there are really no significant benefits accruing from the same.

In case of sale of power to the utilities, states like Gujarat put very stiff conditions for discontinuing the PPA before twenty years. Given the nature of the projects and uncertainties associated with biomass availability, these provisions need to be discontinued.

Plantation /Additional Capacity

There is an issue on creation of additional capacity to an extent of 34000 MW through cultivation of energy plantation. Though it is a good idea that waste lands might provide an opportunity to grow energy plantation and use it for power generation, it is suggested that instead of creating additional capacity the existing biomass based power plants and those under planning stage may be allowed to take on these waste lands and cultivate energy plantation so that viability of these projects will improve and become more sustainable.

The Road Map should form a team of technical experts within the Ministry, who would have specialized knowledge for technically guiding, advising and monitoring energy plantation development in various agro climate, soil and water conditions.

The policy of government land identification for development of energy plantation should be simple. All categories of land which is eligible for energy plantation should be pre-selected and categorized by involving different state departments like forest, District Administration, etc. which makes the identification process more simple.

The responsibility of development of lands should be given to stakeholders who are interested in developing it. Imposing conditions like using NAREGA scheme, responsibility of development to group, who is least concerned or interested in development and are forced for the sake of system demanding it are limiting factors, which is not allowing this scheme to succeed. It can be either given to the power developer or concerned government department or group, who take responsibility of development and have interest in development.

The development of energy plantation would require support of other related departments like watershed management, rural development, agriculture department, Forest department so that schemes and incentive available can be clubbed and synergized for the plantation activity. The plantation would require constructing of water reservoirs for collecting rain water, anikets making, soil enhancement and improvement, shallow well digging etc. There are schemes available in different departments in watershed management, rural development, agriculture etc, which can be synergized for energy plantation development.

The ministry should financially support some pilot energy plantation demonstration projects and there is a need for financial support in the initial period of 3 years, after which the plantation can be carried out with buy back arrangements from the developers.

The credit flow for financing of plantation should be simple both in conditions and process. The financial terms should allow decent moratorium period for payment with less ROI. There should be financial support of Ministry for development in the initial 2 to 3 years to reduce the risk for power developers.

The development of energy plantation should be given the status of agriculture and whatever normal schemes and incentives are available for this sector should also be made available for energy plantation.

Fuel Pass through Mechanism/Biomass Pricing/Tariff

Failure of biomass power plants is mainly caused due to increase in biomass prices every year. The regulators of tariff do not consider the practical market situation while fixing the biomass prices. The biomass prices found to be 50% to 100% higher compared to the prices considered by the regulator. Hence, there has to be a mechanism for automatic revision of tariff order on yearly / bi-annual basis so that projects will become unviable due to higher biomass prices.

There should be one national rate for purchase of biomass power like solar power or it is to be state wise and it should be linked with industrial power rate of the state. (For example, if base rate for billing to industry in a state is Rs.

4.5/KWH, the state utility should purchase power produced from biomass on base sales rate plus Rs. 1.5. This will enable the power producer to get some variable power rate). Alternatively power rate can be linked with rate of coal.

For the small scale (1-2 MW) plant, it is in general mentioned by CERC that the plant cost is around 5-6 Cr/ MW, whereas, it is observed that this cost ranges from 7-8 Cr/MW. Therefore, it is suggested that the CERC should revise the benchmark. This will also have to reflect in the associated tariff.

Biomass prices are variable and they are always compared with coal. Since coal is cheaper, government must control the price of biomass to make it viable alternative for energy.

The tariff for biomass based power generation needs significant changes and must depend on fuel price, so that developers find it attractive.

Technology

Biomass availability, collection and its logistics is a big challenge, so biomass power generation technologies which can offer frequent start-up and shut-down, should be preferred such as biomass gasification (producer gas).

The existing biomass gasification technologies suffer from incomplete fuel conversion (max 85%), lower calorific value of syngas, and presence of tar and poor scalability of the gasification system. In order to efficiently utilize the existing biomass potential, these issues needs to be addressed by developing and demonstrating the newer technologies. In this effort, ministry must support technological development and facilitate its deployment across the country.

Subsidies

Currently the subsidy structure for 1-2 MWe range is fixed, whereas power tariff and biomass price varies significantly. It is suggested that subsidy should be strongly linked to the region/zone, fuel price and tariff for the uniform growth of this technology across the country.

Biomass based Power Plants which are proposed to be installed at district and taluka place, should get more subsidy in comparison of which are being set up in big towns/ cities

Generation Based Incentive (GBI)

One of the significant ways of improving the viability of biomass based projects is through an incentive mechanism like generation based incentive. This incentive may be structured in such a way that it gives a different encouragement to the developers. Since running a biomass power plant consistently involves lot of hardship on the part of the developer, he may be encouraged by giving generation based incentive.

While structuring the GBI it is also important that there should be a strict monitoring of fuels used by the developer and GBI shall be allowed to those companies which use only biomass.

Power Purchase Agreements (PPA)

When a PPA is executed with utility, a developer is not allowed to exit within the PPA period. This is causing significant limitation to the developer; even if the project is unviable he has to continue with the same PPA. There should be a provision for exit from the PPA when other and better opportunities are available to the developer.

Existing power plants

Already a capacity of 1000 MW is created in the country in biomass sector. Some of the plants are either closed or are not working satisfactorily. Hence, any reforms those are framed must be applicable to the existing power plants also.

Courtesy: *MNRE Editorial Team*

Remarks/ Comments/ Suggestions by

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Outcome of the Conference on Biomass Power – Potential, Issues & Challenges Organized by Ministry of New & Renewable Energy, Government of India

Ministry of New and Renewable Energy (MNRE) organized a conference on 'Biomass power – potential issues and challenges' on 27th September, 2011 at India International Centre, New Delhi. This conference was presided over by the Secretary MNRE and attended by the representatives of a number of companies involved in producing Biomass power from different sources. This conference was organized to exhibit the innovative approaches taken by different entrepreneurs to produce Biomass power and sharing the issues and challenges faced by them.

Mr. Deepak Gupta, Former Secretary, Ministry of New & Renewable Energy, interacting with the participants of the conference on Biomass Power - Potential, Issues & Challenges

This conference was inaugurated by the chief guest Mr. Deepak Gupta, Former Secretary, Ministry of New and Renewable Energy. In his opening speech he mentioned that there is lot of potential in India to produce energy from biomass which in the long run can address the country's energy demand but adequate policy support is not there to strengthen it. MNRE is currently thinking about a Biomass Road Map in this regard. The draft document on the Biomass Road Map is uploaded in the website and is open for comments and suggestions. Once it would be finalized and approved, this document would be served as the guidelines for the states for production of biomass energy. He expected that discussions in the workshop could provide a direction towards its implementation in the states.

The Secretary appreciated the efforts of M/s Ankur Scientific Energy Pvt. Ltd. for producing Biomass Gasification Power from crop residue at Sankheda near Varodara which is dedicated for lift irrigation as well as livelihood development in the area. According to him, Biomass Gasifier can not only be used for power generation but also can address the livelihood issues in the country by providing additional revenues to villagers for their otherwise waste.

Dr. G. C. Dutta Roy from M/s Dalkia Energy Services Ltd., principal consultant of MNRE for preparation of the Bioenergy Road Map document explained how to achieve the target of 20000 MW biomass power by 2022. He also mentioned that the road map has been developed with support from MNRE, DFID, UNDP, IISC Bangalore and various studies have been undertaken by them. According to him, production of biomass power in the rural areas using MGNREGA scheme can save the huge expenditure incurred by Government of India for supplying electricity in the villages through grids (Rajiv Gandhi Grameen Vidyutikaran Yojana).

He also mentioned that a field research was carried out on the actual agri-residues produced and collected. Further the survey was extended to study the amount of agri-residue that can be collected using more efficient harvesting collection techniques.

Three main issues came out in the study as the barrier for power production from biomass, which are:

- Lack of policy support in the biomass power production, therefore, policy hurdles needs to be sorted out to achieve the target.
- The availability of wastelands in reality is different from the Forest Survey of India data

Participants of the conference on Biomass Power - Potential, Issues & Challenges

- Policy focus on plantation development for biomass power is essential. There is huge potential of plantation development in UP, MP, Nagaland, Rajasthan and J & K.

According to the research output the immediate potential of the biomass energy is 20,000 MW. He also opined that for the development of plantation of energy crops, synergies between the schemes like Green India Mission, watershed development programmes and rural livelihood development programmes, which are being implemented under different Ministries, are required.

Dalkia group also has done a research on price parity of biomass power with the coal power and recommended that the price parity is around 60-70%. However, the issue of high risk of the biomass power needs to be mitigated through policy support.

A number of presentations were made by different industries viz., M/s Bermaco Energy ltd, M/s Thermax Ltd, Pune, M/s AREVA Renewable Energy India Pvt. Ltd, M/s Zenith Energy, Hyderabad to name a few. They all have shown different cases to face the challenges of the establishing biomass power plant in different socio-political and ecological environments.

Outcome of the Conference

During the panel discussion at the end of the presentations, it was decided that the following issues would be further pursued by MNRE to counter the challenges that lie in the rapid development of the biomass energy market.

- **Issue of Zoning:** It was recommended that for less than 2 MW plant there will be no zoning since the required quantity of biomass would be less.
- **Tariff:** The Ministry will prepare a recommendation report for consideration of the Electricity Regulatory Commissions at the centre and various states for revision of tariff.
- **Size of the power plant:** MNRE will review the issue of size of biomass based power plants.
- **Supply of power to the villages:** In future small plants would be required to supply power to the villages.
- **Related issues of Biomass Power in States:** MNRE has decided to document the related issues of biomass power plants from all states (tariff, regulation, approval mechanism, etc.)
- **Plantation:** For plantation in the non forestry lands / waste lands, a mechanism needs to be established.
- **Involvement of the Forest Department:** The Forest Department needs to be involved in the proposed Biomass Mission urgently, especially for plantation of energy crops in the forest land.
- **Case study of successful initiatives:** Successful example of the biomass projects like dam catchment area project for drifts irrigation in Gujarat, gasification for pump irrigation in UP and Chhattisgarh should be studied.
- **Issues like collateral security:** Collateral security in banks for sanctioning of loan needs to be reviewed. There were views from the participants that Canara Bank & SBI – Agri-hi tech Banks have already started sanctioning loan for installation of the Biomass power plants.

At the end of the workshop an announcement was made that the India Bioenergy Association has been formed by private players and is working towards making better future for the bioenergy companies which in turn will address the issues and concerns of the biomass power production in near future.

WII Editorial Team

Biomass Gasification Based Power Plant – An Ankur Experience

Ministry of New and Renewable Energy (MNRE) is exploring the possibility of generating 10,000 MW of power in the next 10 years from surplus biomass, both agro and forest residues and also by way of dedicated energy plantations. In addition, small megawatt biomass power plants could be set up for feeding power at the tail end of the grid (11 KV line).

These plants would ensure power to many villages and rural India apart from the following major benefits:

- Small plants of up to 2 MW help in improving the voltage of the 11 KV Grids and in improving the power factor. The Grid frequency stabilizes and limits Transmission & Distribution (T&D) losses to a large extent (about 7% losses are prevented).
- Much greater probability of success and long term sustenance.
- Creation of large scale employment for unemployed / partially employed rural people.
- Likely creation of a large number of small entrepreneurs in rural areas.
- Rural / 11 KVA grids become net producers of electricity thus ensuring uninterrupted power supply to rural areas.
- Round-the-clock / on-demand generation of electricity and hence ability to meet peak demand.
- Very short gestation periods of a few months.
- Almost 80% of the cost of generation is returned to the local economy through purchase of biomass and local jobs.
- Perennial and Sustainable Green Power
- Mitigation of Global Warming.
- Increased, long term self sufficiency on the energy front.
- Potential for Co-Generation through inclusion of cold chains in the power projects.
- Greening of barren and waste lands through production of sturdy energy species as small plants are conducive to Energy Plantations, leading to aforestation.

This project is the first case of selling power to third party under the new Gujarat Open Access Regulation Act, 2011.

Recognizing the above benefits, Ankur Scientific has set up its first 1.2 MW, Grid connected, Biomass Power Plant based on its own Gasification Technology in Sankheda Taluka of Vadodara district. This Project would be first of its kind in the State of Gujarat and also the first project to be set up under the status of "Model Investment Project" implemented by The Ministry of New and Renewable Energy (MNRE) and United Nations Development Programme (UNDP) with partial financial assistance from both.

Mr. Deepak Gupta's (Former Secretary, MNRE) visit to Ankur's Sankheda Plant

Mr. Deepak Gupta, Former Secretary, MNRE is planting a sapling at the Sankheda Plant site

The Project has been commissioned in a record time of about six months, right from identification of land, biomass surveys, all permissions, manufacturing and import of state of the art equipments etc. This would not have been possible without the unstinted support of the local villagers and farmers, Panchayats, the Taluka offices, Collectorate and departments of land conversion, Town Planning, District Industry Centre, Pollution Control Board, Gujarat Energy Development Agency (GEDA), the Nodal Agency, Madhya Gujarat Vij Company Limited (MGVCL), Gujarat Energy Transmission Corporation Limited (GETCO) and Ministry of New and Renewable Energy (MNRE). The Project includes many innovations as follows:

Fuel Supply Linkage

The major reliance of biomass is on crop residues of the common crops available near the project site, mainly Cotton Stalks, Tur Stalks, Castor Stalks and Corn Cobs. The surrounding area of the project site is rich in Cotton, Tur and Maize cultivation. The farmers and villagers are very willingly giving their agri-residues, which are also providing them some added revenues for their otherwise waste, which was generally burnt off on the fields.

Development of Entrepreneurs for Secured and Sustained Fuel Supply

In the above process Ankur Scientific is also developing Entrepreneurs out of these farmers and villagers for Secured and Sustained Fuel Supply. The project not only attracted the villagers and farmers to be part of it, but it also provided additional revenues towards the supply of their otherwise waste feed stocks.

This being the first year, a few young enthusiasts amongst the villagers and the farmers are being identified who would be trained and developed into Entrepreneurs. They would then manage on their own the supply chain on sustainable basis.

Technology

The waste heat recovery has been included in the 1.2-MWe Power project, having two units of WBG-850 Gasifiers along with three units of 400 kWe Engines to ensure high overall efficiencies.

Waste Heat Recovery for VAM chiller

The "Ankur" Biomass Gasification system requires chilled water for the heat exchanger to cool the producer gas and condense the moisture in the producer gas. A normal scroll type chiller is used for this purpose wherein the power consumption of the chiller is about 45 kW-hr.

Ankur's Biomass Power Plant at Sankheda

Dr. B.C. Jain (Chairman, Ankur Scientific), Mr. D.P. Joshi (Director, GEDA) and Mr. VK Jain (Director, MNRE) with Mr. Deepak Gupta (Former Secretary, MNRE) at Ankur's Sankheda Plant

To reduce the power requirement for the overall auxiliaries, Ankur is recovering the waste heat / flue gas from one of the engine exhaust transferring it to Hot Water through a heat exchanger and the hot water is then being fed into a VAM chiller to generate 36 TR chilling with a temperature profile of 13 – 8°C. In this case the total power requirement for the VAM chiller including its auxiliaries would be about 17 kWh.

Waste Heat Recovery for Biomass Drying

As in the above case, the waste heat/ flue gas from the two other engines exhaust is being utilized for Biomass drying. The flue gas is being used in the two bin dryers having total capacity of 16 m3 volume, which will be sufficient to meet the dried biomass requirement of the two Gasifiers. The bin dryers will reduce the moisture content in the biomass to less than 20% as that is preferable in "Ankur" systems.

Utilization of Charcoal / Biochar

The quantity of char produced is approximately 5% of weight of the biomass used. Further, the char is discharged through the dry ash char removal system and getting collected in bags and hence no fly ash is generated.

Char from "ANKUR" Gasifier has a reasonably high calorific value and can be useful as a fuel for small-scale industries requiring thermal energy. It can also be used as filler-cum-fuel by brick kilns, as filler in concrete hollow bricks, as a raw material in the manufacturing of precipitate silica etc. and hence part of this is planned to be sold off to such units at a nominal price.

Briquetting of Char

The char as discharged from "Ankur" systems are segregated as follows:

Sizes above 10 mm would be initially sold and then later planned to be given to the villagers for cooking.

Sizes below 1 mm would be given to the local farmers as biochar for soil addition as it increases the fertility of the soil and thereby the yield.

Sizes between 1 mm and 10 mm are used for briquetting. A separate briquetting machine has been installed at the project site and the briquettes thus made would initially be sold to industries for their thermal application and thereafter in the long run Ankur intends to give part of the briquette / charcoal to the local villagers for smokeless cooking.

Sludge Utilization

The system is designed to minimize the sludge and even this small quantity is mixed with the dry discharge of 1 to 10 mm size for briquetting as briquetting requires certain moisture with the dry ash – char. Thus, the circle is fully closed with no waste stream being let out.

Courtesy: Dr. B. C. Jain,
Managing Director, Ankur Scientific Technologies Pvt. Ltd.,
Email: bcjain@ankurscientific.com

Crop Residue Management: Establishing Efficient Systems and Equipments

Large amount of farm residue is produced along with the crops grown every year on the farm. For every tonne of crop produced an equal or in some cases more than double the amount of biomass is produced. Many estimates with respect to surplus biomass available have been made by various organizations and individuals but all these differ. However, it is estimated that about 600 million tonnes of biomass is produced every year and out of which about 150-200 million tonnes is surplus. It is either ploughed back into the soil to enrich the soil or it is burnt which causes environmental pollution or is used as feed material for feeding to the animals. It is also now being used as feed material for generation of producer gas using gasifiers. In some states gasifiers of more than 1 MW have been installed for generation of producer gas which is feed to the engines coupled to the alternators for generation of electricity. One tonne of biomass can be used for generation of 300 kWh of electricity or 2 to 2.5 tonnes of compost. Due to ban on burning of farm residues, the farmers are finding it extremely difficult to collect the biomass and have problem in its safe handling and disposal. Incorporation of straw into the soil requires lot of energy and time. A good number of farm machines for cutting, shredding, incorporation, collection, handling and transportation of farm residues are available in India and abroad.

One tonne of biomass can be used for generation of 300 kWh of electricity or 2 to 2.5 tonnes of compost. Due to ban on burning of farm residues, the farmers are finding it extremely difficult to collect the biomass and have problem in its safe handling and disposal. Incorporation of straw into the soil requires lot of energy and time.

The various machine systems available for cutting, collection, handling, densification & transport of biomass are described in this article.

Straw Burning: The Old Method of Crop-Residue Management System

Management of paddy straw in the combine harvested fields has become a big problem. On an average, for every 4 tonnes of wheat or paddy, nearly six tonnes of straw are produced. Previously, most of this straw was being burnt causing environmental pollution, loss of available nutrients which otherwise could have contributed to the income of farmers and it added inert material into the soil causing degradation of soil health.

By-products Available from Crops and their Uses

Before we discuss the different machines available, we need to know the different by-products available and their possible uses (Table 1).

Crop Residue Management Systems

The challenges associated with crop residue management are:

Non- perennial nature of crop residue: Residues are available in the field for 2 to 4 weeks. During this time, all of the material must be harvested, collected, transported and put into protected storage for gainful use.

Diffuse nature of the crop residue: The low density of straw spread on the field enhances the cost of collection and also poses problem for mechanized operation like raking etc. This means that the total amount of crop residue available is large, but the amount available per unit area is relatively small and the cost of collection and transportation are relatively high.

Machines for Farm Residue Management

Stubble Shaver

It is tractor PTO operated equipment which cuts and spreads the trash in the field. It consists of cutting blades (swinging flails) joined to the bar, gear box for transmission of power at right angles. It is used for the clearance of shrubs, monsoon growth in forests, fields, mostly used for cutting grasses and also for cutting stubbles of

Table1: Byproducts Available from Different Crops and their Present Uses

Crop	Production (Million Tones)	Estimated farm residues available (Million Tones)	Byproduct	Uses
Wheat	84	126	Straw	As Animal Feed, for Soil enrichment in biogas plants, for production of ethanol through biomethanation using enzymes, paper & pulp production for making boards
Paddy	94	141	Straw	As animal feed in Southern parts of the country, for soil enrichment in biogas plants, in gasifiers for generation of electricity, for production of ethanol through bio-methanation, paper & pulp production, ply Boards
			Husks	In gasifiers for generation of electricity, in *chulas/sigris*
Sugarcane	335	21.6	Green Tops	For feeding to the animals
			Sugarcane Trash	For burning in gasifiers, for enriching the soil by incorporation, as mulch in the field, utilisation as energy source in cold storages & thermal applications
			Baggase	For use in sugar mills for generation of electricity
			Molasses	For ethanol production
Cotton	19.43 million bales of 170 kg each	29.40	Stalks	As fuel wood for cooking, for making particle boards, for making paper & pulps, for making corrugated boxes, for making briquettes & use in Gasifier
			Leaves	For feeding in biogas plants, for use in Gasifier after briquetting, in biogas plants
Jute & Mesta	10.95 million bales of 180 g each	1.5	Sticks	For making particle boards, for making ropes, for thermal application, briquetting, for making different products from composites
Pigeon pea	3.08	9.0	Stalk	For use in gasifiers, thermal applications, cooking and making briquetting,
			Leaves and branches	Used as fodder, roof thatching material and fuel
Soyabean	10.97	5.9	Stalks	For use in Gasifier Briquetting
			Leaves and branches	For thermal application
Goundnut	7.37	5.0	Shells	For briquetting & use in gasifiers

sugarcane and standing paddy/maize stalk left in the field after harvesting and helps in subsequent sowing of wheat by Zero till drill. The cut material then can be either incorporated into the soil or collected from the field using different machines are:

Rotavator

Rotavators is used for land preparation operation. It cuts the standing straw and incorporates it into the soil. It is operated by tractor PTO. It is available in different widths ranging from 120 cm to 180 cm to suit the different size of power available. It saves 30-35 % time in field preparation and reduces cost of operation by 20-25 %. Wheat and paddy is being harvested manually using sickle or using combines. The manually harvesting results in cutting very close to the ground and hence all the straw is recovered from the field. But harvesting by combines usually leaves about 30 cm of standing straw in the field. So either this standing straw has to be ploughed back into the soil using disc plough or disc harrow, rotavator or straw shredder etc., or it needs to be recovered from the field using different machines. The standing straw is usually burnt in the field which causes huge environmental pollution in the area.

Due to ban on burning of the straw, the farmers are left with no choice but either to plough back the straw into the field or recover it from the field.

Tractor Mounted Sugarcane Trash Shredder

Shredders are used for chopping the farm residue into small pieces which are left in the field after combine harvesting. This helps in subsequent sowing of the next crop under no-tillage conditions. Shredders are not available in India though some attempts have also been made in India to make shredders. Handling of sugarcane trash and its disposal is a big problem. Presently 8 to 10 tonne/ha sugarcane trash is being burnt due to shortage of labour and prohibitive cost of composting. Incorporation of trash after chopping reduces decomposing period to one half and also enriches soil. Hence a tractor mounted sugarcane trash shredder has been developed by Mahatama Phule Krishi Vidyapeeth (MPKV), Pune which is an adaptation of rotavator with provision of trash gathering and trash pressing unit.

Straw Chopper cum Spreader (Flail or Cutter Bar Type)

For incorporation of paddy straw into the soil, a tractor operated straw chopping-cum-spreading machine has been developed By Punjab Agriculture University (PAU), Ludhiana in association with the manufacturer. They are of two types, flail type and cutter bar type. The machine in a single operation harvests the left over paddy stubbles after combining, chop it into pieces and spread onto the field. The chopped and spread stubbles then can easily be buried in to the soil after a light irrigation by use of rotavator or disc harrows and allowed to decay. This machine consists of a rotary shaft mounted with flail blades to harvest the straw and a chopping unit consisting of knives. The machine has found great acceptability amongst the farmers of Punjab as it helps in incorporation of paddy straw into the soil and checks environmental pollution and providing rich organic manure.

Rotary Disc Mower

It is an offset mounted implement consisting of rotary discs of about 30 cm dia having a set of knives mounted on its periphery. It has paired rows of 2 or more discs which rotate in opposite direction. It generally has either 4, 6 or 8 discs. It is operated by tractor PTO and operates at high speed. The power to the discs is provided by the PTO. Due to impact action, the farm residue and standing stubbles are cut by knives and thrown on the field. It requires 60 HP or above tractor for its operation. These are at present not being manufactured in our country but are being used extensively in countries abroad for harvesting forage crops. One unit has been imported and is being tried at Govind Vallabh Pant University of Agriculture & Technology (GBPUAT) farm at Pantnagar.

Happy Combo Seeder

Happy combo seeder combines two units, one straw management unit and another sowing unit. Straw management unit cuts and lift the standing paddy stubbles and loose straw and throws this material behind the sowing unit on the sown field or can be collected in a trolley moving behind it. Thus this machine completes the sowing operation in combine harvested field in a single pass at the same time retain the rice residue as surface mulch. It was developed by PAU, Ludhiana in association with Australia.

Straw Collection, Handling and Baling

Manual Collection of Loose Paddy Straw

It has been seen that both the machines related to direct tillage namely; zero-till drill and strip-till drill which can function smoothly in the clean field free from loose straw thrown by the combine harvester. There is one more option that this loose straw should be collected manually and stocked on the side of the farm. Collection of straw manually by hand rakes takes time and involves drudgery. It has been observed that this exercise requires 2-3 man days depending upon the straw moisture of the crop and the field condition.

Tractor Drawn Rakes

It is an instrument consisting of a row

Straw Collection Machines

Happy combo seeder

Straw combine with trolley

Modified straw combine

Straw Bailing Machines

Rectangular Straw Baler

Round Straw Baler

Table 2: Common Types of Field Balers

Baler Type	Approx. bale size, cm	Approx. bale weight, kg	Approx. bale density, kg/m^3
Conventional	36x46x110 (common in India)	18-20 20-25	110-120 (wheat) 125-130 (rice)
Rectangular	40x46 40x58 (cross section) and120-125 (length)	-	-
Big rectangular	150x150x230 80x80 (cross section) and120-125 (length adjustable to250)	300	65
Big Round	180(dia)x 150 cm 120(dia)x 120 cm	350-500	100

of teeth set in a headpiece attached to a long shaft and used for gathering hay, straw, leaves, etc., or for smoothing loose earth. Rotary rakes are key to higher quality hay and forage. Few pieces have been imported and are being tried in India and it holds good promise. The rake collects the loose straw and leaves it in a windrow in the field which can later be picked up by the baler and made into bales.

Straw Baler

Straw baler is a very promising technology for collecting straw from the field and making into bales. The machine collects the loose straw left by combine harvester, compresses it and deliver the same in the form of rectangular or round bales. They are of two types namely, square or round balers. The round balers can also be used for making round bales of the grape twigs or uprooted cotton sticks lying in the field.

A round baler has a feed roll to lift the windrow. Straw is then passed through belts which compress and roll it like a sheet to form a cylinder or roll bale. When the desired diameter of the roll bale is achieved, the feed roll stops. The roll b ale continues to revolve and a binding twine is wrapped round the bale. The bale is then discharged and windrow lifting and conveying mechanism is automatically re-engaged. Bale weight is 200 kg or more.

Straw Reaper/Straw Combine

The machine is a new innovation by Department of Farm Power & Machinery, PAU, Ludhiana and the machinery manufacturers of Punjab for recovery of wheat straw from the combine harvested field. The wheat straw is fed to the cattle in the form of bhusa that is finely cut and crushed. To collect and bruise the wheat straw and stubbles left behind after use of grain combine, a wheat straw combine has been developed. This machine cuts and gathers the left over straw from the field, chops it into fine straw and blows it into a trailers attached at the rear of the machine. It consists of a cutting mechanism, conveying mechanism, a bruising unit and a blower. The straw combine recovers 25 q/ha of straw in addition to 100 to 120 kg of grain per hectare. The Central Institute of Agricultural Engineering, Bhopal has redesigned the tractor drawn straw combine with trailer with the straw collection container mounted over the straw combine itself to improve field maneuverability and simplifying loading and unloading.

Fully assembled self-loader trailer with prototype baler and grapple during initial testing in April 2008

Bales of woody biomass produced by the prototype and research balers

Handling and Transport of Farm Residues

The biomass handling is an important aspect considering low density of material for loading and unloading. Mostly, the manual methods are used for loading the trolleys. In India biomass is loaded into bullock carts or tractor trolleys manually. In developing countries equipment and systems have been developed for loading and unloading of bales.

Traditional transport of carrying on head, shoulder or shoulder sling or even as animal pack have lost relevance except where material to be transported are in very small quantities and for a short distance. Tradition bullock, camel or and horse carts are good for about 1-1.5 tonne(t) of pay load. Pneumatic wheeled bullock carts can pull up to 2-3t of payload at 2.5-3.5 kmph and are still found economical for 5-10 km lead distance. Tractorised farms are seen keeping a pneumatic wheeled bullock cart for on-farm fodder, farm produce and input movements. The movement of loose straw should be immediately banned as it results into road accidents while being moved in loose form from one place to another on bullock carts, tractor trolleys and trucks. The loose straw is wrapped in cloth which bulges out from the carts, trolleys or trucks and have been found to result in road accidents.

For transportation we are primarily concerned with loading and unloading operation and transferring biomass from preprocessing sites to biorefinery. Truck transport and for a few cases train transport may be the only modes of transport. The movement of the loose straw should be immediately banned. The government should promote transportation of the straw in baled form or feed block form by starting custom hire service.

Crop residue being transported in a truck

Traditional straw transportation

Conclusion

The Indian agriculture is characterized by having a dominating facet of energy and nutrient wastage due to inefficient utilization of crop-residues. The trappable and valuable energy and nutrient component of crop residues are normally being wasted mostly by burning the crop residues in the field. It is due to the fact that the market costs of residues are not profitable in comparison to the expenditure involved for collection, handling, transportation, storage and marketing of crop residues. Besides, inadequacy of cheap labour at the small span of rabi and kharif harvesting season prompted the farmers for burning the crop residues in the field. In our country, the collection of crop residues from field has low level of mechanization at present; the manual method being most prevalent. However, other unit operations, namely chopping, grinding, bailing, densification, handling and transportation can be accomplished using the mechanized systems of commercial in nature. In India, the status of using the mechanized systems for crop residue management is at lower level due to small farm holdings, unawareness of farmers and no agency to take up this task. The mechanized equipment/techniques are available and there is need to adopt and popularize these machines for crop residue management.

There are two aspects towards the management of crop-residues; one is nutrient management and other is energy extraction. For nutrient management, complete retention of crop residues at the soil surface by using zero or reduced tillage systems may be promoted. In areas where there is high demand for animal feed, an adequate amount of residue (partial removal of crop residues from the soil surface) must be left on the field to provide soil surface protection.

For enhancing the energy security in rural areas, the crop residues may be collected and used for generating the thermal and shaft power for different applications using suitable technologies. The generation of electrical power utilizing the crop residues is one of the promising options. Since crop-residues are non-commercial fuels, there is a huge fluctuation in their pricing. The volume of crop-residues is high due to lower bulk density, imposing a cost limitation due to transportation cost. Consumers and producer of this energy resource should be involved in the process of collection and conversion of crop-residue in usable form for fuel purposes. Cooperative societies may serve as crop-residue collectors and farmers may be shareholders. The farmer's cooperative may be promoted to collect and process the crop-residue to bales/briquettes, convert a part of these briquettes into gaseous fuel or steam to generate power. Surplus briquettes have market value in industrial sector. The electricity generated by farmers themselves by using their own local energy resources will strengthen the power security at farms.

Courtesy: Dr. S. K. Tandon, *formerly Assistant Director General (Engg.), Indian Council of Agricultural Research*
Email: skt4339@yahoo.com

Biomass Based Green Technologies: Potential and Sustainability

Gasification is a century old technology, which is used to convert biomass into combustible gaseous fuel called Producer Gas (PG). The technology flourished quite well before and during the Second World War. The technology disappeared soon after the Second World War, when liquid fuel became easily available[1]. The interest in gasification technology has undergone many ups and downs till date. Today, because of depletion in fossil fuels, hike in fuel prices and because of environmental concern, there is a renewed interest in this century old technology. Gasification has become more modern and a quite sophisticated technology[2].

Some of the important merits of gasification technology are as follows[3]:

- Provides all forms of energy namely, electrical, mechanical and thermal.
- No net addition of CO_2 into atmosphere or carbon neutral technology.
- Advantageous for remote areas having biomass but no electrical power supply.
- Useful for power level ranging from 3 kW to few MW.

Some of the interesting applications of Producer Gas are[3]:

- Water pumping for irrigation,
- Local power generation,
- Flour mill grinding, and
- Brick kiln operations.

India is strongly determined to become an energy independent nation and the constant quest for clean and sustainable energy sources are in progress. Energy from renewable source like biomass is very critical in meeting the growth targets in power sector(s) and also overall economy. Biomass in an energy mix has already taken over other conventional fuels in usage and has become almost prominent fuel next to major conventional fuels as shown in Table 1[4]. Apart from this, there are several biomass based technologies (discussed at later stage) contributing towards clean environment and electricity generation. The sky rocketing growth in world's population Figure 1[5], depletion of fossil fuels Figure 2[6] and rise in carbon-dioxide (CO_2) emissions leading to greenhouse effect are all driving force towards renewable[7,8,9] and sustainable green technologies.

Table 1: Fuel usage and purpose 2007-2008[4]

Fuel	LCV (MJ/kg)	Usage (mmt/year)	Purpose
Coal	20	400 20	Electricity Steam raising/Heating
Natural Gas	50	12	Electricity, transport, cooking
High speed diesel	42	40	Heavy vehicle transport
Naphtha	42	12	Stationary power generation
Light diesel oil	--	02	
Fuel oil	40	14	Electricity via diesel engine
Gasoline	42	09	Vehicle transport
Kerosene	42	12	Cooking/transport
Liquefied Petroleum Gas	45	10	Cooking urban transport
Firewood	16	250	Cooking electricity
Agro residues	14	120	Industry and rituals
Cowdung	13	40	

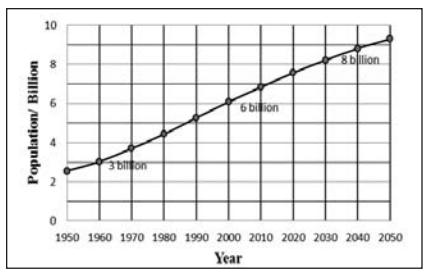
Source: "International Energy Agency" (IEA)-(2006-2007), "World Energy Outlook" & GEF -2006

Potential for Bio-energy in India

It is estimated that there are 3870 (106) hectare (ha) of forest worldwide (refer Table 2) or 30% of the earth's land area, of which about 95% are natural forests and 5% are plantations[10]. Tropical and subtropical forests comprise 56% of the world's forests, while temperate and boreal forests account for 44%. The average area of forest and wood land per inhabitant varies regionally. The area varies between 6.6 ha in Oceania, 0.2 ha in Asia, and 1.4 ha in Europe (3.4 ha in the Nordic countries). This fact indicates that the potential contribution of wood to the energy supply also varies from country to country[11].

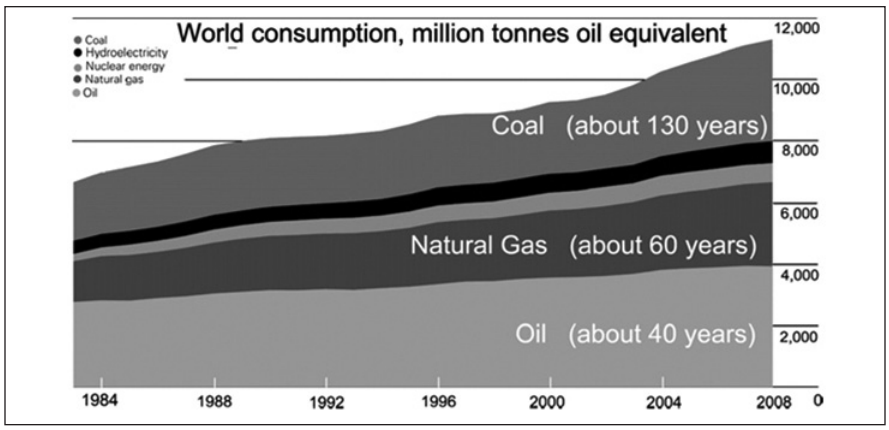
In the recent years, the interest in using biomass as an energy source

Figure 1: Estimated World's Population (1950-2050)



Source: Population Division, United States Census Bureau International Database[5]

Figure 2: Fossil fuel consumption (1983-2008)



Source: British Petroleum Annual Review; June 2009[6]

Table 2: Forest resources, area (ha), (2000)[10-11]

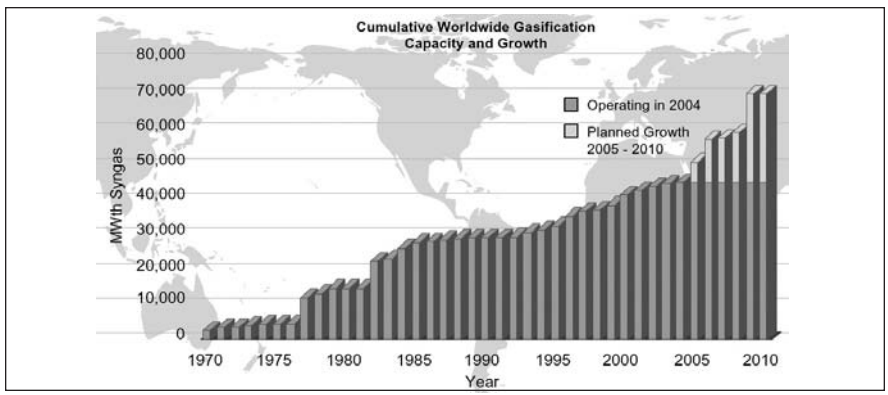
Continents	Land area (106) (ha)	Forest Area (106) (ha)	%	Plantation (ha) (106)	Forest area per capita (ha)
Africa	2978	649	21.8	8	0.8
Asia	3084	547	17.8	115	0.2
Europe	2259	1039	46.0	32	1.4
North & central America	2136	549	25.7	2	1.1
Oceania	849	197	23.3	3	6.6
South America	1754	885	50.5	10	2.6
World	13063	3869	29.6	171	0.6

has increased and it represents approximately 14% of world final energy consumption. Estimates have indicated that 15–50% of the world's primary energy use could come from biomass by the year 2050[12]. Since India is basically an agricultural based land it is, therefore, very rich in biomass besides having forests and waste lands. The cumulative biomass data and cumulative biomass residue data is shown in Table 3 and 4.

Biomass based power generation in India is an industry that attracts investments of over ₹ 600 crores every year, generating more than 5000 million units of electricity providing yearly employment of more than 10 million man-days in the rural areas[12]. The two promising pathways for biomass energy conversion are, Bio-Chemical Route (BCR) to generate biogas fuel and Thermo-Chemical Route (TCR) to generate PG fuel. However, this article is focused towards TCR pathway.

Besides solar energy and wind energy, biomass got recognized as an ideal energy resource for decentralized energy systems. In tropical countries like India, biomass grows more productively, which can be converted efficiently into modern energy carriers such as gaseous, liquid fuels and electricity that can be used in a more affluent society[14]. India, an oil-importing country, with nearly 70% of its population living in half a million villages and hamlets across the country and rich in bio-resources is ideally suited for biomass-based technologies[15]. India has estimated to install 200,000 MW by 2012 to meet electricity demand which is 60 % more to what country has at present. By 2020, India requires 400,000 MW of electricity because of rapid growth in industrialization and population[16]. The potential of biomass based power generation as discussed in context with Table 3 and 4, is useful in meeting the forecasted energy targets. Survey projects, biomass as a renewable energy source, which can help humanity, if it is harnessed to its full potential[17]. Biomass gasification technology has received attention worldwide and remains attractive and promising in meeting future energy demands. Figure 3 shows the historic view of gasification usage for the last 35 years. It also indicates the planned continuous growth and expanding opportunities, including substantial contributions to world energy needs[18].

Figure 3. Cumulative worldwide gasification growth chart[18]



Source: U.S Department of Energy, Office of Fossil Energy Brochure, NETL, 2004

Table 3: Cumulative biomass data of India (2002-2004) -All class of biomass[13]

States of India	Area (kHa)	Crop Production (kT/Yr)	Biomass Generation (kT/Yr)	Biomass Surplus (kT/Yr)	Power Potential (MWe)
Total	262363.8	495845.6	666515	249074	33295.4
Agro-Total	143540.9	495845.6	511041	145026.6	18728.7
F & W-Total	118822.9	0	155474	104047.4	14566.6

Biomass class: *Agro, forest and waste land*
F & W: *Forest and Wasteland*

Source: http://lab.cgpl.iisc.ernet.in/Atlas/

Table 4: Cumulative residue biomass data (2002-2004) - All Season

Crop*	Residue*	Area (kha)	Crop Production (kT/Yr)	Biomass Generation (kT/Yr)	Biomass Surplus (kT/Yr)	Power Potential (MWe)
Total		127118.2	231340.1	415529.4	101864.4	12744.8

*Residue: Straw, Stalks, Husk, Pod, Cobs, Shell and Leaves
*Crop: Paddy, Wheat, Maize, Soybean, Mustard, etc.
Source : Biomass resource Atlas of India

Table 5: BET's greenhouse gases reduction potential in India[19]

Biomass Technology	Technical Potential	Global environmental benefit (million Tonne Carbon per year)
Biogas	17 million	5
Community biogas	150000 villages	10.8
Improved stoves	120 million	4
Biomass	57000 MW	89
Co-generation	3500 MW	6
Urban wastes	1700 MW	3

Source : Journal Energy - Vol: 34, Issue: 08, Aug.2009

Technological Developments

In context to climate change, great environment concern is expressed over release of CO_2 from the burning of fossil fuels. This was the reason for steady increase of CO_2 content of atmosphere. CO_2 contributes to 50 % of greenhouse effect. One of the remedies to limit the rising content of CO_2 in the atmosphere is enhanced use of biomass fuel. India's CO_2 intensity is also one of the lowest at 0.22 kg of CO_2 per dollar (GDP_PPP). This compares with 0.61 for China, 0.50 for US and 0.47 as global average. However, the significant rise in emissions can be controlled in India with the Bio-Energy Technologies (BET) as shown in Table 5[9,19].

Biomass is any plant and plant-derived material obtained from photosynthetic reaction of CO_2 with water vapor. In the context of energy source, biomass can also include woody plants, residues from agriculture or forestry, and the organic component of municipal and industrial wastes. Since the biomass based feedstock is cyclic (renewable), it qualifies as a sustainable source of energy as long as it is used at a rate comparable to or less than the rate of production. The energy derived from plant or plant-derived materials is called as Bio-energy, which can be produced using gasification technology coupled with gas engine route[20]. The gasification process takes place in a reactor unit called gasifier, wherein the biomass fed from top of a down draft gasifier. Approximately 10 - 15% of moisture undergoes complex chemical oxidation and reduction reactions in a reactor flowing through different zones namely, drying zone, pyrolysis zone, oxidation zone and reduction zone. The major reactions (at 25°C & 1 atm) responsible for generating combustible components of a PG such as H_2, CO and CH_4 are the Boudourd reaction ($CO_2 + C$ ---- $2CO$ - 172.6 MJ/kg-mole), Watergas reaction ($C+H_2O$---$CO+H_2$ - 131.4 MJ/kg-mole), $C+ 2H_2O$---CO_2+2H_2 -88.0 MJ/kmol, Water shift reaction ($CO+H_2O$---CO_2+H_2 + 41.2 MJ/kmol), $C+2H_2$ ---- CH_4 + 75MJ/kmol. To ensure complete cracking of higher molecular weight molecules the reacting mixture along with reactive char is left with some duration at an oxidation zone (900 -1200°C) for cracking. The challenge for gasifier manufacturers lies in generating superior PG quality having particulate and tar matter less than 1 microgram/Nm^3 which is vital from a gas engines operational view point. Apart from these, gasifier also contains cleaning systems like, cyclone separator, fabric filter and cooling systems like scrubber and chiller to filter the contaminants like dust, particulate matter (PM) and tar associated with raw PG at the exit of gasifier outlet. The producer gas engine is provided with a carburetor system such that the required air to fuel ratio of 1.3 to 1.4 is maintained over entire range of flow rates, thus permitting the variable load operation. The typical composition of PG based on open top re-burns down draft gasifier (designed by C.G.P.L., IISc., Bangalore) using causurina wood with moisture content between 12% and 15% on dry basis (sun-dried wood) is 19 ± 1 % H_2; 19 ± 1% CO; 2 % CH_4; 12 ± 1% CO_2; 2 ± 0:5 % H_2O

and rest, N_2. The mean calorific value of gas varied around 4:65 ± 0:15 MJ/ Nm^3[21].

Economics and benefits

Some of the economical benefits of using this gasification technology are: a) Electricity generation at a cheaper rate compared to grid, b) Qualifies for clean development mechanism (CDM) benefit and c) Small disposal cost or landfill maintenance cost for the local bodies. Some of the environmental benefits of gasification route apart from being carbon neutral (as long as it is used in renewable manner) are low in terms of NOx, CO and SO_2 emissions. Hence it is a green technology. A 1.0 MWe plant has the capacity to provide direct employment for about 40 - 50 people. Particularly when working with solid waste it becomes an asset which otherwise was thought to be a liability. Solid waste of 20 - 25 tonne/day (with organic content of about 60%) would suffice for a 0.2 MWe plant with a Plant Load Factor (PLF) of about 80%. The cost of electricity from biomass through gasification coupled with gas engine as the variable cost at about ₹ 2.2 per kWh and biomass price of around ₹ 1.4 per kg. The contribution from fixed cost for 80% PLF would add ₹ 0.6 per kWh. Many of the plants when operate round the clock the capacity utilization of the plant becomes as high as 80 -90%. The plant with such a high PLF is able to provide accelerated return to the investor apart from additional revenue in the form of by-product such as activated carbon. Hence choosing a specific load utility and proper estimation of power load is vital from PLF view point[20].

Conclusion

The interest in using biomass as an energy source has increased and it represents approximately 14% of world's energy consumption. Estimates indicate that 15–50% of the world's primary energy use could come from biomass by the year 2050. India requires 400,000 MW of electricity by the year 2020. Biomass power generation in India can meet certain percent of this future demand. It is also effective in generating rural employment opportunities and controlling the significant rise in emissions with the BET's. PLF of 80% and above is achievable with Gasification Technology (GT). Besides this, the GT also qualifies for CDM for carbon trading benefits.

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Courtesy: Mr. M. Sreedhar Babu, Dr. Shibu Clement, *Dept. of Mechanical Engg., BITS, Pilani-K.K.Birla Goa Campus, &* Dr. N.K.S. Rajan, *Dept. of Aerospace, C.G.P.L. Indian Institute of Science, Bangalore*
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Co-creating Stoves with User Community

The need and implications of propagating improved biomass cook stoves are yet to be well understood at ground level by policy level practitioners. However, with recent impetus provided by the Ministry of New & Renewable Energy and other agencies towards encouraging new designs and dissemination strategies; renewed interest in the subject has been observed. While some designs in the market are available, often their success level has been low on account of several factors. Very often consumers find it difficult to grasp the concept – understand the impacts of improved cook stoves on health, environment, savings and drudgery reduction. Paying for a stove, which they otherwise can construct for practically free, poses dilemma and more often the basic utility and functionality of the design is not akin to the consumers' requirements and expectations.

To counter these issues and also develop an effective dissemination methodology, practitioners – both stove designers and distribution partners (NGOs, commercial distributors etc.) are encouraged to co-create products with consumers as opposed to undertake conventional laboratory based design and prototyping. Co-creation translates into developing a product from a conceptual stage or with an abstract prototype with the users – where the technical experts, designers and users become one cohesive unit. This approach ensures that while the users understand some of the basic technical issues such as air flow, insulation etc. , designers and technicians understand the problem faced by users and their priorities better – making each others problems their own and thus solving them better. Co-creation also ensures that a more empathetic approach is adopted as opposed to using communities feel like passive consumers.

Given the quantum and variety of traditional stove designs used in India with specific requirements of different user groups, it is critical to categorize broad cooking types and work with multiple user groups within the identified segment. The Greenway Grameen Infra, follows these basic design rules across all products. The first example of the same is the Greenway Smart Stove for which the design team travelled across 5 states and 1,50,00 kilometers, conducting design camps and co-creating prototypes and their improvements in the field itself.

Greenway Smart Stove for which the design team travelled across 5 states and 1,50,00 kilometres, conducting design camps and co-creating prototypes and their improvements in the field itself – A snapshot

To capture the essence of India's kitchens and develop a viable solution in the form of a 'likeable and efficient' modern and efficient chulha, Greenway's team embarked on a journey across the country to learn from local experiences in chulha construction and understand local cooking needs. Despite the progresses made in terms of LPG penetration, it is clear that millions of households would continue to use biomass based chulhas for the coming years.

While chulhas are almost always made from locally available materials such as mud, bricks and at times metals (in the form of sariya, dishes etc.) & cement, they offer great levels of customization suited to family size, cuisine, portability, cost of construction etc. Almost all across the country, the dominant fuel mix entails wood, dry dung and agro-waste.

Immense variety is observed in the design, even for the same design variations in cooking habits particularly in terms of the fuel mix and fuel feeding habits. Richer households have greater propensity to use cow dung whilst poorer households rely primarily on hard firewood. In some cases the use of chimneys and vents in the kitchen area are also observed. Regional factors determining designs are listed below:

- Family size
- Availability of construction materials
- Cuisine
- Portability and kitchen roof height

Some of the notable chulhas studied are presented in the above collage

- Cost of construction
- Local taste and construction knowledge

A summary of the primary observations regarding usage habits are:

Inside and Outside/ Portability

It was noticed that simple mud chulhas (as in Rajasthan) are dominant in areas deemed most poor. Given the ease of construction and zero cost of construction for these 'all mud chulhas' families often construct one each inside the house (kitchen) and one outside (courtyard). The outside chulha is used during good weather and before dark since emissions from the outside chulha are a lot less problematic for the user. Portable chulhas with metal dish based bottoms and mud/clay casings are commonly used outdoor. Given the investment in metal for such chulhas and the difficulty in constructing, they are kept indoors when not in use to retain their form.

Cook and Simmer

Households at times maintain chulhas with two adjacent chambers – one for cooking and the other for simmering. Fire is maintained in the 'cooking chamber' while hot ash and charcoalized wood is retained in the 'simmering chamber'. Heat lost from the fire in the cooking chamber is partially captured by its simmering counterpart to provide an overall efficient system. Cooking on both chambers is not a common cooking practice as maintaining fire and bearing the smoke generated becomes difficult when both are used.

Income Levels and Choice of Construction Materials

A fundamental correlation exists in between cooking practices and income level. The presence of a separate kitchen area in rich households compared to the use of the chulha in the living room itself in poor households is very conspicuous. Additionally, while the poorer households use simple mud constructions; the use of brick and metal is witnessed in relatively better off households while the next higher income group often uses metal, cement and brick based constructions.

Food Habits and Grill Design

Populations preferring wheat based diets are known to prefer no grill chulhas in order to directly heat rotis on the flame whereas in areas where rice is preferred, a solid load bearing grill like structure/support of mud, tapered brick etc. is dominant. Meat eating areas also prefer strong flames with support grills.

While these are broader consumer requirements, in depth interactions and design camps revealed how well communities especially women understand 'combustion' given their daily experience with lighting chulha fires. Additionally co-creation enables practitioners to understand user purchase patterns and evolve most viable ways of marketing the final product once adoption is ensured in the design configuration itself. Greenway's team has been working on a composite design and marketing strategy that ensures that the user community is in the centre of all initiatives. The presented approach also ensures rural communities are given due respect and treated as rational consumers and particular problems in communication/awareness generation are solved.

Role of Marketing in promoting a good design

Many are indifferent of marketing and believe that it has no place in socially-oriented projects often assuming that if a product has utility in the social context it will 'sell itself'. However, practitioners must realise that the knowledge from which they develop this opinion is practically unknown to the target user segment who needs to be made aware of the product concept and value and cannot be expected to learn and imbibe the same by themselves. This is where appropriate marketing becomes essential. Appropriate marketing can be used to generate awareness in an exciting and at times entertaining fashion and can engage communities further towards enhancing the benefits of the products beyond its core utility.

Courtesy: Mr. Ankit Mathur,
Co-founder, Greenway Grameen Infra Pvt. Ltd.
Email: ankit@grameeninfra.com

Cook Stove Project in India – Registered under CDM

SAMUHA is a development organization working in the South Indian state of Karnataka since 1986. SAMUHA works with vulnerable people to improve their quality of life as a group process.

It works towards building communities of people, who will identify issues, find solutions; and ultimately walk on their own. People's ownership remains a priority in their projects.

The purpose of the project activity was to replace inefficient traditional cook stoves in 21,500 households with efficient fuel wood single/double pan "Chulika" cook stoves, in a biomass deficient district of Koppal, Karnataka State in India. This district has greatly diminished biomass resources and the wood demand far exceeds the available renewable woody biomass. The CHULIKA cook stove saves 67.5% of households' fuel wood. By reducing fuel wood consumption, the project activity reduced green house gas (GHG) emissions stemming from the use of non-renewable biomass. According to estimation, Chulika cook stoves saves 2.31 t of CO2/yr/family in this region. The project activity is expected to prevent 46,668 tCO2 emissions in a year by implementing Chulika stoves in 21,500 households, and a total of 466,678 tonnes of CO2 for a period of 10 years.

Type of Technology

The Chulika is a single/double pot stove based on a rocket stove design of which single pot has a thermal efficiency of 30.8% and the double pot stove has a thermal efficiency of 40.3%. The combustion chamber of the stove is made of lightweight ceramic mixed with binders. The combustion chamber is cast, dried and fired in a kiln and is a one piece refractory casting. Chamber housing is deep drawn in a high tonnage hydraulic press and powder coated. The chamber shell is made of mild steel. The chamber top plate is pressure die cast out of light weight aluminum alloy. The wood grate is made of galvanized steel wire and welded. On the side is a port for feeding fuel into the combustion chamber. After lighting, air draft flows into the combustion chamber from under the wood grate. This design ensures preheating of the air and a complete combustion with no visible smoke and only small amounts of ash. The stove is suitable for rural household cooking wherein cooking, frying, baking flat bread, heating water for bathing can be conveniently carried out, replacing the traditional cook stove.

The chosen technology involves energy efficiency improvement in thermal application of non-renewable biomass by introduction of high efficiency biomass fired cook stoves for cooking and heating water.

CDM Requirements/ Additionality

Taking into account the national and/ or sectoral policies and circumstances, the emissions reductions would not have occurred in the absence of the proposed small-scale project activity. The project had to overcome

investment barriers and it was unlikely that improved cook stoves would have been implemented in the project area. In the absence of CDM, these barriers would automatically lead to continued use of traditional cook stoves for cooking and heating water for bathing, leading to higher emissions. Apart from this, the improved cook stove technology had no market share in the villages compared to the baseline cooking technology. Thus, the traditional mud stove which was financially a more viable alternative to the project activity and was less technologically advanced had lower risks to performance uncertainty and thereby, leading to higher emissions. On the other hand, the project activity had low market share and was technologically more advanced. This was proved by low penetration of improved cook stove for cooking in rural households of Karnataka.

It was proved to the CDM Board that the project as a CDM activity enabled Chulika for cooking to overcome the different barriers and promoted improved cook stoves in the project area. Thus, the project activity was proved to be clearly additional because it was financed completely through the revenues from forward financing of CER sales, and could not be realized without the revenues from carbon credits. Therefore, in the absence of the CDM project, which provided the upfront investment for the establishment of cook stoves in 21,500 households for the rural poor, this project would not have happened.

CDM Specific Details

Name: Improved Cook Stoves CDM project of SAMUHA

Reference No. : 4772

Sectoral Scope: 3 - ENERGY DEMAND

Project Type: II - ENERGY EFFICIENCY IMPROVEMENT PROJECTS

Project Category/ Methodology: II.G. Energy efficiency measures in thermal applications of non-renewable biomass, Version 3

Date of registration: 12 May 2011

CER: 46668

Sources:
http://www.samuha.org &
http://cdm.unfccc.int/Projects/DB/PJR%20CDM1304601410.01/view

Biomass Resource for Power Generation in India

Biomass a Key Resource in Renewable Basket

Biomass still remains the primary source of energy in rural India accounting for approximately 15% of India's total energy needs. The systematic introduction of biomass as alternate energy source in industrial and commercial space happened as a sequel to first the oil shock in the early seventies and later as an alternate form of energy in our quest to reach the elusive energy security. In the current energy-environment scenario, with growing demand in energy and dwindling availability of fossil resources, shift to renewable energy source is an obvious option and biomass as a renewable resource or a carbon neutral source becomes a champion candidate in the emerging low carbon economy.

Thermax Limited (TL) started its journey into biomass in seventies and subsequently accelerated the technology developments in eighties when oil shock starting from seventies forced industries to move away from oil based boilers for process heating applications to solid fuel fired boilers. Coal was the natural solid fuel and the early developments were based on coal based systems both in fluidized bed and stoker based designs. TL perfected both the designs (discussed in the body of the article) and developed several concepts using coal for process heating in medium, small scale and commercial segments of the industry.

Current Status of Biomass Power Developed by Thermax

Principle

The biomass is collected, sized (wherever required) before firing in the boiler. There it burns and the heat liberated during the combustion is used for steam generation at a specific pressure and temperature .This steam is expanded over a steam turbine and the rotary motion of the turbine drives an electric generator thus generating electricity.

Biomass based power generation are limited in nature primarily due to the availability constraints of the biomass and is generally used in the capacity range of 2- 15 MW. These boilers are generally designed considering a variety of fuels so that the cyclical nature of the biomass availability do not pose a challenge to the power generation .

Thermax has, till date, supplied more than 5000 biomass boilers for the process of heating and power generation.

Biomass

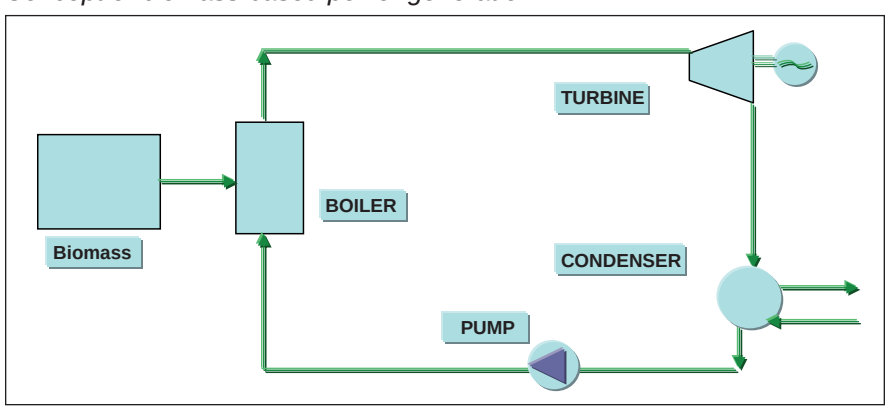
Biomass is a non fossil fuel and is derived from wood, wood waste, agricultural residue like baggasse, rice husk, coconut shell, groundnut shell, coffee husk etc. Biomass is considered to be a carbon neutral fuel, as the CO_2 generation during the combustion process is balanced by the CO_2 absorption during the plant growth. The structure of biomass is essentially cellulosic with lignin and hemi cellulose intertwined depending on the source of biomass. This result in high volatile content compared to other solid fuels and this is one major differentiator between biomass based energy conversion device to conventional solid (coal) fuels.

Biomass spectrum

Till 20 years back the only available biomass were Bagasse , wood logs/ chips, saw dust , rice husk and ground nut shells .Then new additions was forced due to increasing cost of above biomass fuels ,liquid fuels and high ash related issues of Indian coal .

Thermax had really taken the

Concept of biomass based power generation



A 12 MW power plant using biomass + RDF as fuel at M/s Shalivahana Green Energy Power, Andhra Pradesh

challenge of studying different biomass/ agro residues and coming with suitable combustor and boiler designs to make sure of satisfactory plant availability .Common biomass being used for steam and power generations are indicated in table 1.

Table 1 shows the Classification of commonly used biomass based on the degree of difficulty in using biomass as a boiler fuel.

In addition to the above list of biomass, many entrepreneurs have successfully started energy plantations in uncultivable land which are not suitable for agriculture.

Early use of biomass

Biomass was initially used as a substitute for solid fuels like coal and lignite, and the initial biomass was wood logs and the use was only limited to process heating applications.

Later as the boiler technology got improved in dealing with biomass, biomass was also accepted as a fuel for power boilers.

Challenges in using biomass as an alternative fuel

Due to their lower calorific value and lower bulk density, these fuels are voluminous in transportation and calls for large equipment for handling and storage. These fuels are fibrous, non-homogeneous and not free flowing, which create a significant problem in metering and feeding. Some of these fuels could have higher moisture and lower calorific value, which may have difficulty to sustain flame and calls for support fuel. Higher moisture in fuel also leads to the lower efficiency of the boiler.

Table 1

Biomass – easy to use	Biomass – medium difficulty in using	Biomass – difficult to use	Biomass - extremely difficult
Wood logs/chips	De-oiled bran/cake	Mustard stalk	Rice straw
Rice husk	Sunflower husk	Palm empty fruit bunch	Wheat straw
Bagasse	Soya straw	Cotton seed hull	
Groundnut shell	Cotton stalk /chilly stalk	Coffee husk	
	Palm kernel shell		
	Coconut shell		
	Spent coffee		

Technology Selections

Thermax started collecting details of biomass way back in 1980. Based on varies studies conducted and field feedback, Thermax decided to deploy appropriate technologies for different biomass fuels. In the case of paddy husk, fluidized bed technology is well established, where as when dealing with bagasse, spreader stoker option is offer considered. However, when a highly fouling fuel like mustard stalk is to be burnt, a pusher grate will be the best choice. The spreader stoker, fluidized bed combustion and pusher grate /pulsating grate combustion are discussed below.

Spreader stoker

Here the sized fuel (say husk / bagasse / wood chips) is fed over the grate with the help of a mechanical device called spreader. The smaller particles burn in the suspension and the heavier particles fall over the grate and burn in thin film. The amount of fuel burning in the suspension is the function of particle distribution, air distribution and temperature profile in the furnace. This type of spreading may lead to higher emission level and incomplete combustion loss if sufficient residence time is not available in the furnace.

To minimize the incomplete combustion loss, particle collected in hopper can be re-injected in the furnace. This type of fuel spreading

Figure 1: Travelling Grate with Spreader Stroker (Courtesy: Thermax Ltd.)

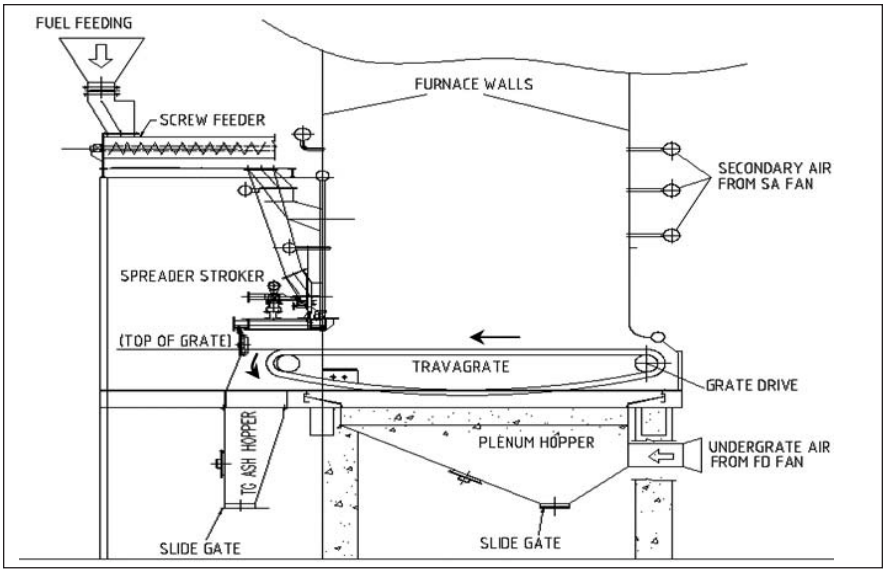
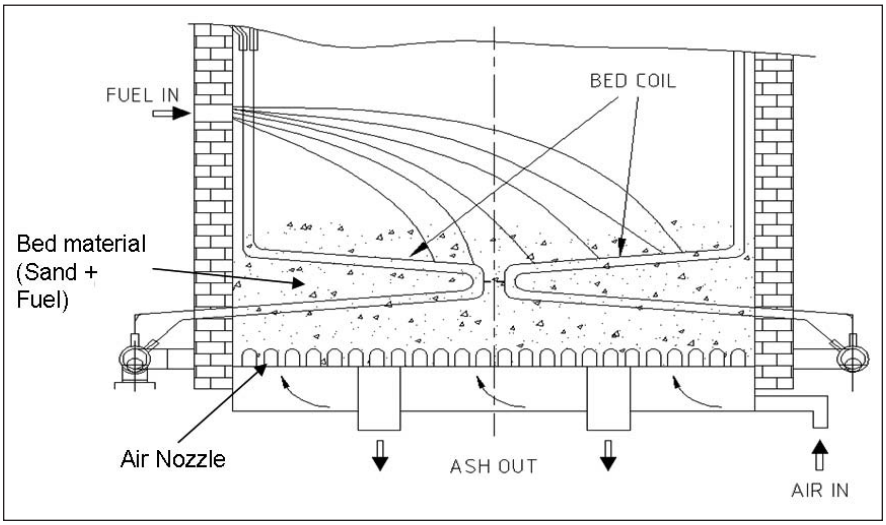


Figure 2: Fluidized Bed Combustor (Courtesy: Thermax Ltd.)



mechanism can be used with stationary grate, pulsating grate and traveling grate stoker. This can burn a large variety of the fuel. The speed of the grate needs to be adjusted to ensure the complete combustion of the fuel.

Fluidised bed combustion system

In this type of combustion process, the fuel bed is fluidized by the injection of air from the bottom of the bed through a set of air nozzles. This results in very turbulent air and fuel mixing leading to very efficient combustion and heat transfer.

Pusher grate combustion system

Another popular method of direct combustion of biomass is pusher grate combustion. Here especially in the case of fouling fuels like spice waste, mustard straw, wheat straw etc. the fuel is introduced at one end of the grate and with the rocking action (pulsating) of the grate ,the fuel travels forward while it is getting burnt with this kind of combustor, the likelihood of fuel particles carried along with flue gas is minimum in comparison to spreader stoker and fluidized bed combustion and thus minimizes the issues related to fouling of the tube banks .

Heat transfer side issues in dealing with biomass

Fouling of boiler surface and its abatement

In the case of many Biomass fuels, alkaline elements like Sodium & Potassium are present in its ash ,which gets vaporized during combustion . The chlorine present in the fuel reacts with the alkali metals results in the formation of low melting alkali chlorides and gets deposited on the heat transfer surfaces and paths. Eventually this deposit not only reduces heat transfer process but also blocks the flue gas path which calls for shutting down of the boiler for cleaning .

This can be minimized by either avoiding the sublimation of alkaline metals in ash by having low furnace temperature or Co-firing of coal along with the biomass .The sulphur and silicates in the coal ash forms alkali sulphates and silicates which are of high melting point compounds and not of fouling nature. This also prevents chlorine corrosion of the pressure part.

Corrosion of super heater coils and its prevention

Presence of chlorine in the fuel results in formation of HCl which ends up in corrosion of super heater whenever the steam temperature exceeds about 450 deg.C .Special metallurgy / appropriate coating for super heater tubes are done to prevent the super heater corrosion .

The Future of Bio-Power in India

Going forward, as renewable energy based power plants start assuming

A fouled super heater banks due to the use of a biomass containing high alkaline content in its ash

critical status, biomass power plants will assume greater importance. The challenge will be adding diverse types of biomass and its derivatives like agro waste and even refuse derived fuels from Municipal Solid Waste (MSW) and developing systems in a hybrid manner.

India's capacity to add 16,000 MW through biomass-the biomass based power is in the cusp of renaissance.

The first and the foremost paradigm shift will happen when the biomass based power units may shrink in size from 12 MW to sub 3 MW size as distributed power plants to be connected to back end of the grid or to be operated in a off-grid mode.

One challenge, which will continue to bog down the biomass based power plants is the assured availability of bio mass over the life cycle of the plant at reasonable cost structure.

Policy Interventions

In any development and deployment of new technology – and more particularly in the renewable technology – Technology and Policy engines need to be synchronized if it has to get impregnated in the society. Biomass also needs policy interventions.

Conclusion

As India moves into high growth trajectory, we will need to harness all forms of energy and biomass power is one such credible option that India would do well to maximize. India needs "built in India" indigenous technologies, component level manufacturing base from MSME sectors, large numbers of project developers, mini grids, power electronics for biomass distributed plants etc. to propel India as a biomass power leader. Needless to mention along with technology development, necessary manufacturing facilities and right kind of financial instruments will make such a vision a distinct possibility. Like solar mission, biomass mission is a necessity for fast proliferation of Biomass based power plants in India.

Courtesy: Dr. R.R. Sonde,
Executive Vice President, Research, Technology & Innovation, Thermax Ltd.
Email: rsonde@thermaxindia.com

Request for Articles

Bioenergy India offers a useful platform for experts, investors and other stakeholders to exchange their experiences, expertise and to discuss issues related to harnessing biomass energy in an efficient and cost effective manner. The magazine encompasses the full spectrum of biomass energy sector related information, which will help creating awareness about the same amongst the relevant audiences.

The magazine tries to bring an overall perspective by bringing out the experiences, information related to this key sector for a wider benefit of the Renewable Energy community. Bioenergy India, therefore, intends to meet the updated information requirements of a diverse cross-section of stakeholders from various end-use considerations, be it biomass combustion, gasification or cogeneration. To meet such an objective in a timely manner, the editorial team of the magazine invites articles, features, case studies and news items, etc., from academicians, researchers and industry professionals.

The contributions should be of about 2,000-2,500 words (approximately 5-6 pages, which would include relevant graphs, charts, figures and tables). The two lead articles would be given an honorarium of ₹ 1,500 each. Please send in your inputs along with relevant photographs to:

Sasi M (sasi@winrockindia.org)
Winrock International India: S-212, 2nd Floor, Panchsheel Park, New Delhi-110 017; Mob: 09910201677

Biomass Power Generation Potential, Incentive and Tariff – A Snap shot

Biomass has always been an important energy source for the country considering the benefits it offers. It is renewable, widely available, carbon-neutral and has the potential to provide significant employment in the rural areas. Biomass is also capable of providing firm energy. 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. Ministry of New and Renewable Energy has realised the potential and role of biomass energy in the Indian context and hence has initiated number of programmes for promotion of efficient technologies for its use in various sectors of the economy to ensure derivation of maximum benefits. 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. For efficient utilization of biomass, bagasse based cogeneration in sugar mills and biomass power generation have been taken up under biomass power and cogeneration programme.

Biomass power & cogeneration programme is implemented with the main objective of promoting technologies for optimum use of country's biomass resources for grid power generation. Biomass materials used for power generation include bagasse, rice husk, straw, cotton stalk, coconut shells, soya husk, de-oiled cakes, coffee waste, jute wastes, groundnut shells, saw dust etc.

Potential

The current availability of biomass in India is estimated at about 500 millions metric tones per year. Recent studies sponsored by the Ministry has estimated surplus biomass availability at about 120 – 150 million metric tones (MmT) per annum covering agricultural and forestry residues corresponding to a potential of about 18,000 MW (current surplus is 51 MmT per year with power potential of 7000 MW). This apart, about 5000 MW additional power (Table 1) could be generated through bagasse based cogeneration in the country's 550 Sugar mills, if these sugar mills were to adopt technically and economically optimal levels of cogeneration for extracting power from the bagasse produced by them.

Table 1: Potential for Bagasse Based Cogeneration in Major Sugar Producing States in India

State	Potential (in MW)
Maharashtra	1250
Uttar Pradesh	1250
Tamil Nadu	450
Karnataka	450
Andhra Pradesh	300
Bihar	300
Gujarat	350
Punjab	300
Haryana & Others	350
Total	**5000**

Technology

Combustion

The thermo chemical processes for conversion of biomass to useful products involve combustion, gasification or pyrolysis. The most commonly used route is combustion. The advantage is that the technology used is similar to that of a thermal plant based on coal, except for the boiler. The cycle used is the conventional ranking cycle with biomass being burnt in high pressure boiler to generate steam and operating a turbine with generated steam. The net power cycle efficiencies that can be achieved are about 23-25%. The exhaust of the steam turbine can either be fully condensed to produce power, or used partly or fully for another useful heating activity. The latter mode is called cogeneration. In India, cogeneration route finds application mainly in industries.

Cogeneration in Sugar Mills

Sugar industry has been traditionally practicing cogeneration by using bagasse as a fuel. With the advancement in the technology for generation and utilization of steam at high temperature and pressure, sugar industry can produce electricity and steam for their own requirements. It can also produce significant surplus electricity for sale to the grid using same quantity of bagasse. For example, if steam generation temperature/pressure is raised from 400oC/33 bar to 485oC/66 bar, more than 80 KWh of additional electricity can be produced for each tonne of cane crushed. The sale of surplus power generated through optimum cogeneration would help a sugar mill to improve its viability, apart from adding to the power generation capacity of the country.

Deployment

The Ministry has been implementing biomass power/co-generation programme since mid nineties.
A total of 288 biomass power and cogeneration projects aggregating to 2665 MW (Table 7) capacity have been installed in the country for feeding power to the grid consisting of 130 biomass power projects aggregating to 999.0 MW and 158 bagasse cogeneration projects in sugar mills with surplus capacity aggregating to 1666.0 MW. In addition, around 30 biomass power projects aggregating to about 350 MW are under various stages of implementation. Around 70 Cogeneration projects are under implementation with surplus capacity aggregating to 800 MW. States which have taken leadership in implementation of bagasse cogeneration projects are Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Uttar Pradesh. The leading States for biomass power projects are Andhra Pradesh, Chhattisgarh, Maharashtra, Madhya Pradesh, Gujarat and Tamil Nadu.

Manufacturing Base

Manufacturing capability exists in the country for the equipment/ machinery required for setting up Biomass Projects. Except for some critical control equipment, most of the equipments can be procured from indigenous sources.

Boilers

A number of large manufacturers have established capabilities for manufacturing spreader stoker fired, traveling grate/dumping grate boilers; atmospheric pressure fluidized bed boilers and circulating fluidized bed boilers.

Table 2: Summary of Biomass Power Cogeneration Tariff Across States
(As on 31.03.2011)

State	Tariff fixed by Commissions	RP0 %
Andhra Pradesh	@₹ 4.28/kWh, (2010-11) - (Biomass) ₹ 3.48/kWh - (Cogen)	Min. 3.75%
Chhattishgarh	@₹ 3.93/Unit (2010-11) - (Biomass)	5%
Gujarat	@₹ 4.40/unit (with accelerated depre.) - (Biomass) @₹ 4.55/unit (with accelerated depre.) for 1st 10 yrs - (Cogen)	10%
Haryana	@₹ 4.00/unit - (Biomass) @₹ 3.74/unit - (Cogen) 3% escalation (base year 2007-08)	1%
Karnataka	@₹ 3.66 per unit (PPA signing date) ₹ 4.13 (10th year) - (Biomass) @₹ 3.59/unit, (PPA signing date) ₹ 4.14/unit (10th Year) - (Cogen)	Min.10%
Kerala	@₹ 2.80/unit (BM) escalated at 5% for five years (2000-01)	3%
Maharashtra	@₹ 4.98 (2010-11) - (Biomass) @₹ 4.79/unit (Comm yr.) - (Cogen)	6%
Madhya Pradesh	@₹ 3.33 to 5.14 /unit paise for 20 yrs. With escl of 3- 8paise	0.8%
Punjab	@₹ 5.05 /unit, (2010-11) - (Biomass) @₹ 4.57/unit (2010-11) - (Cogen) escalated at 5% -cogen, & 5%-BM	Min. 3%
Rajasthan	@₹ 4.72 / unit-water cooled (2010-11) - & ₹ 5.17-air cooled(2010-11)-(BM)	1.75%
Tamil Nadu	@₹ 4.50-4.74/unit(2010-11) - (Biomass) @₹ 4.37-4.49/unit (2010-11) - (Cogen) (Escalation 2%)	Min. 13%
Uttaranchal	@₹ 3.06/unit. (2010-11) - (Biomass) @₹ 3.12/unit (2010-11) - (Cogen) (new projects)	9%
U.P.	@₹ 4.29 / unit, for existing and 4.38 for new with escalated at 4 paise/year, base year (2006)	4%
West Bengal	₹ 4.36/unit fixed for 10 years - (Biomass)	4%
Bihar	₹ 4.17/unit (2010-11) - (Biomass) ₹ 4.25/unit (2010-11) – existing - (Cogen) ₹ 4.46/unit (2010-11) – new - (Cogen)	1.5%
Orissa	₹ 4.09/unit	

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Due to recent upsurge of interest in co-generation for surplus power, leading manufacturers are further upgrading their capabilities for high efficiency boilers.

Steam Turbines

Almost all combinations – condensing, single extraction/double extraction condensing, back pressure, etc. are now being offered in the country with full after sales services guarantees. The efficiencies of turbines now being offered are comparable to the best in the world.

Other Equipment

Apart from the main equipment, there is a well established capability and capacity for manufacture of related equipment for use of biomass for energy including harvesters, balers, briquetting equipment, handling and firing equipment, pollution control systems, etc. Many multinational companies have set up manufacturing facilities in the country for such equipment.

Promotional Policies

Besides the Central Financial Assistance mentioned in Table 3, fiscal incentives (Table 6) such as 80%

Table 3: Central Financial Assistance and Fiscal Incentives for Biomass Power Project and Bagasse Cogeneration Projects by Private/Joint/Coop./Public Sector Sugar Mills

Project Type	Capital Subsidy	
	Special Category States (NE Region, Sikkim, J&K, HP & Uttaranchal)	Other States
Biomass Power projects	₹ 25 lakh X (C MW)^0.646	₹ 20 lakh X (C MW)^0.646
Bagasse Co-generation by Private sugar mills	₹ 18 lakh X (C MW)^0.646	₹ 15 lakh X (C MW)^0.646
Bagasse Co-generation projects by cooperative/ public sector sugar mills 40 bar & above 60 bar & above 80 bar & above	 ₹ 40 lakh* ₹ 50 lakh* ₹ 60 lakh* Per MW of surplus power@ (maximum support ` 8.0 crore per project)	 ₹ 40 lakh* ₹ 50 lakh* ₹ 60 lakh* Per MW of surplus power@ (maximum support ` 8.0 crore per project)

* *For new sugar mills, which are yet to start production and existing sugar mills employing backpressure route/seasonal/incidental cogeneration, which exports surplus power to the grid, subsidies shall be one-half of the level mentioned above.*

@ Power generated in a sugar mill (-) power used for captive purpose i.e. net power fed to the grid during season by a sugar mill.

Note: CFA and Fiscal Incentives are subject to change.

Table 4: CFA for Bagasse Cogeneration Project in Cooperative/Public Sector Sugar Mills implemented by IPPs/State Government Undertakings or State Government Joint Venture Company / Special Purpose Vehicle (Urja Ankur Trust) through BOOT/BOLT model

Project Type	Minimum Configuration	Capital Subsidy
Single coop. mill through BOOT/BOLT Model	60 bar & above 80 bar & above	₹ 40 L/MW of surplus power* ₹ 50 L/MW of surplus power* (maximum support ` 8.0 crore/ sugar mill)

* *Power generated in a sugar mill (-) power used for captive purpose i.e. Net power fed to the grid during season by a sugar mill.*

Table 5: CFA for Bagasse Cogeneration Project in Existing Cooperative Sector Sugar Mills Employing Boiler Modifications

Project Type	Minimum Configuration	Capital Subsidy
Existing Cooperative Sugar Mill	40 bar & above 60 bar & above 80 bar & above	₹ 20 L/MW of surplus power* ₹ 25 L/MW of surplus power* ₹ 30 L/MW of surplus power*

* *Power generated in a sugar mill (-) power used for captive purpose i.e. Net power fed to the grid during season by a sugar mill. CFA will be provided to the sugar mills who have not received CFA earlier from MNRE under any of its scheme.*

Note: CFA and Fiscal Incentives are subject to change.

Table 6: Fiscal Incentives for Biomass Power Generation

Item	Description
Accelerated Depreciation	80% depreciation in the first year can be claimed for the following equipment required for co-generation systems: 1. Back pressure, pass-out, controlled extraction, extraction–cum-condensing turbine for co-generation with pressure boilers 2. Vapour absorption refrigeration systems 3. Organic rankine cycle power systems 4. Low inlet pressures small steam turbines
Income Tax Holiday	Ten years tax holidays.
Customs Duty	Concessional customs and excise duty exemption for machinery and components for initial setting up of projects.
General Sales Tax	Exemption is available in certain States

Table 7: State-Wise/Year-Wise List of Commissioned Biomass Power/Cogeneration Projects (As On 31.03.2011) (in MW)

State	Up to 31.03.2003	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	Total
Andhra Pradesh	160.05	37.70	69.50	12.00	22.00	33.00	9.00	20.00	-	363.25
Bihar	-	-	-	-	-	-	-	-	9.50	9.50
Chhattisgarh	11.00	-	-	16.50	85.80	33.00	9.80	43.80	32.00	231.90
Gujarat	0.50	-	-	-	-	-	-	-	-	0.50
Haryana	4.00	-	2.00	-	-	-	-	1.8	28.00	35.80
Karnataka	109.38	26.00	16.60	72.50	29.80	8.00	31.90	42.00	29.00	365.18
Madhya Pradesh	-	1.00	-	-	-	-	-	-	-	1.00
Maharashtra	24.50	-	11.50	-	40.00	38.00	71.50	33.0	184.50	403.00
Punjab	22.00	-	-	6.00	-	-	-	34.50	12.00	74.50
Rajasthan	-	7.80	-	7.50	8.00	-	8.00	-	42.00	73.30
Tamil Nadu	106.00	44.50	22.50	-	42.50	75.00	43.20	62.00	92.50	488.20
Uttarakhand	-	-	-	-	-	-	-	-	10.00	10.00
Uttar Pradesh	46.50	12.50	14.00	48.50	--	79.00	172.00	194.50	25.50	592.50
West Bengal	-	-	-	-	-	-	-	16.00	-	16.00
Total	**483.93**	**129.50**	**136.10**	**163.00**	**228.10**	**266.00**	**345.40**	**447.60**	**465.00**	**2664.63**

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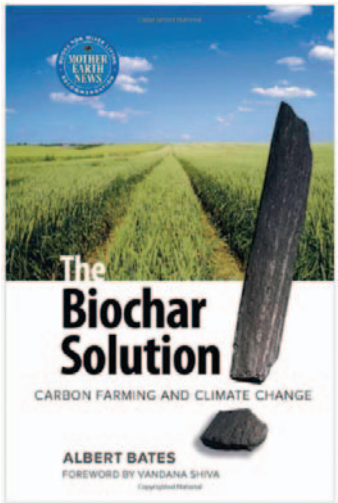
accelerated depreciation, concessional import duty, excise duty, tax holiday for 10 years etc., are available for Biomass power projects. The benefit of concessional custom duty and excise duty exemption are available on equipments required for initial setting up of biomass projects based on certification by Ministry. In addition, State Electricity Regulatory Commissions have determined preferential tariffs and Renewable Purchase Standards (RPS). Indian Renewable Energy Development Agency (IREDA) provides loan for setting up biomass power and bagasse cogeneration projects.

Source: *http://www.mnre.gov.in/prog-biomasspower.htm*

What to Read



The Biochar Solution explores the dual function of biochar as a carbon-negative energy source and a potent soil-builder. Created by burning biomass in the absence of oxygen, this material has the unique ability to hold carbon back from the atmosphere while simultaneously enhancing soil fertility. Author Albert Bates traces the evolution of this extraordinary substance from the ancient black soils of the Amazon to its reappearance as a modern carbon sequestration strategy.

Combining practical techniques for the production and use of biochar with an overview of the development and future of carbon farming, The Biochar Solution describes how a new agricultural revolution can reduce net greenhouse gas emissions to below zero while increasing world food reserves and creating energy from biomass wastes.

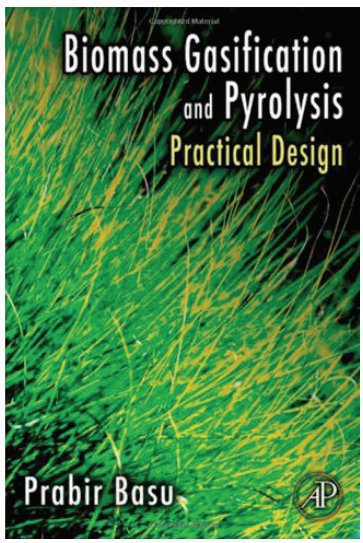
Biochar and carbon farming can:

- Reduce fossil fuels inputs into our food system
- Bring new life to desert landscapes
- Save cooking and heating fuel with super-efficient stoves
- Help build carbon-negative homes, communities and nations.

Biochar is not without dangers if unregulated, and it is not a panacea, but if it fulfills its promise of taking us back from the brink of irreversible climate change, it may well be the most important discovery in human history.

Albert Bates was a civil sector representative at the Copenhagen climate conference, trying to point the world back towards a stable atmosphere using soils and trees. His books include Climate in Crisis and The Post-Petroleum Survival Guide and Cookbook. Working with the Global Ecovillage Network he has taught appropriate technology, natural building and permaculture to students from more than 60 nations.

Source: *http://www.amazon.com/Biochar-Solution-Farming-Sustainable-Agriculture/dp/0865716773*



Modernized biomass gasification for power generation has attracted increasing interests as an attempt to reduce our reliance on fossil fuel. Over the past couple of years, a lot of RD&D has gone into overcoming the technical hurdles of biomass gasification mainly producing clean gas. Biomass Gasification Design Handbook offers engineers and scientist a hands-on reference for understanding and successfully overcoming these hurdles. In this book, readers find a versatile resource that not only explains the basic principles of energy conversion and biomass conversion systems but also provides valuable insight into the design of biomass gasifiers. Thorough in his coverage, the author provides many worked out design problems, step-by-step design procedures, and real data on commercially operating systems. In addition, the book contains valuable appendices that eliminate the need to search for essential information.

Dr. Prabir Basu, the author is an active researcher and designer of gasifiers with a specific interest in fluidized-bed gasification of biomass. His current research interests include frontier areas, such as supercritical gasification, as well as applied research dealing with biomass co-firing. He is the founder of the prestigious tri-ennial International Conference series on Circulating Fluidized Beds, and founder of Greenfield Research Incorporated, a private research and development company based in Canada that specializes in fluidized-bed boilers and gasification.

Professor Basu has been working in the field of energy conversion and the environment for more than 30 years. Prior to joining the engineering faculty at Dalhousie University (formerly known as the Technical University of Nova Scotia), he worked with both a government research laboratory and a private boiler manufacturing company. Dr. Basu's passion for the transformation of research results into industrial practice is well known, as is his ongoing commitment to spreading advanced knowledge around the world. He has authored more than 200 research papers and six monographs in emerging areas of energy and environment, some of which have been translated into Chinese and Korean.

Source: *http://www.amazon.com/Biomass-Gasification-Pyrolysis-Practical-Design/dp/0123749883*

What to Attend

World Future Energy Summit

January 16-19, 2012, Abu Dhabi, UAE

World Future Energy Summit in its 5th edition continues to provide the leading platform for international policy makers, innovators, business decision makers and investors to explore global energy challenges with the view to creating real and sustainable solutions.

In 2012, WFES will bring together more than 150 eminent thought leaders to reveal the latest innovations and discuss the burning issues surrounding future energy. This is an opportunity to hear cutting-edge information, gain first hand knowledge, and discuss with international colleagues the challenges and solutions for achieving clean, secure and sustainable energy for all.

This year's Summit program has been designed to address the theme *Powering Sustainable Innovation*. As the global demand for energy continues to escalate, it is innovation which will transform our traditionally fossil fuel based energy into a diverse mix featuring renewable and sustainable energy sources. It is innovation which will enable the development of advanced clean energy technology and continue to make huge leaps forward in improving energy efficiency.

Throughout the four days of the Summit, the underlying theme of innovation will be seen across the framework of policy, business, technology and finance with ground breaking presentations from industry leaders, open discussions among senior representatives from key players and valuable insights from respected analysts.

Issues to be discussed at the summit include:

- Technology as the enabler for a clean energy future
- Driving the growth of sustainable energy
- Financing sustainable energy for all
- Wind: Powering up – seizing opportunities
- Transforming cities: Establishing sustainable communities
- Gas: The role of gas in a low carbon economy
- Sustainable transportation: Systems, policies and technologies
- Energy efficiency: The key to carbon reduction
- Innovation in future energy financing
- Energy and rural development
- Innovating the future energy mix
- Bioenergy: Biomass for power generation
- Carbon capture and storage: What's next?
- Solar technology and innovation
- The role of nuclear energy in a sustainable energy future
- Energy storage: Technical challenges, Market opportunities
- Digital energy: The smart infrastructure
- International regulations and trade: Global networks
- Future energy, future strategies

Source: http://www.worldfutureenergysummit.com/

Biomass Partnerships Conference

March 1, 2012, Wels, Austria

A conference dedicated to biomass heat contracting and other partnerships across the biomass value chain is going to be organized in the frame of the IEE-project FOREST.

Conference topics:

- Biomass supply chains
- Biomass heat contracting
- Financing and operation of biomass heating systems & plants
- Biomass district heating, micro-grids

Source: http://www.wsed.at/en/programme/biomass-partnerships/

News Snippets on Biomass Power

1 Delhi Buses to Run on Biofuel

Delhi Transport Corporation (DTC) buses will soon be running on fuel derived from vegetable waste and sludge from treated sewage. The Centre has struck a deal with the Swedish government to set up a compressed biofuel plant at Delhi Jal Board's Keshopur sewage treatment plant (STP). The fuel produced at the plant, which will start functioning in two years, will be cleaner and cheaper than CNG opined by a Delhi Jal Board (DJB) official.

He also viewed that large amount of sludge is mounted at the sewage treatment plants and there is no way of disposing it off. At several plants DJB has started biogas production, which will be used to run certain operations there. The production of biofuel will take place the first time. A feasibility study has been carried out for this pilot project. The Centre and the Swedish government will soon sign an agreement for cost sharing on an equal footing for the project estimated at Rs 25 crore. Biofuel will be produced using both sludge and organic compostable waste from a nearby wholesale vegetable market. Around 20,000 cubic meters of compressed biogas will be produced daily at the plant.

DJB is already producing biogas using sludge at two other plants - Rithala and Okhla. At Okhla, the biogas is being supplied to about 2,000 households. However, DJB plans on discontinuing the project for the time being. Three other STPs are also set to get biogas production plants - Dwarka, Yamuna Vihar and Kondli. At these plants DJB is exploring the option of producing power using biogas.

Source: http://timesofindia.indiatimes.com/city/delhi/DTC-buses-to-run-on-biofuel/articleshow/10296309.cms

2 Power Company to Set up Solar Energy Plant

In a bid to popularize environmental-friendly energy sources, Noida Power Company Limited (NPCL), is going to build a 1 MW solar power plant and distribute the power generated through women self-help groups. The company is setting up the solar power plant near its substation in Surajpur in Greater Noida. It is simultaneously developing the self-help groups through a separate programme in association with a Delhi-based NGO called Development Initiatives.

Electricity from the solar power plant would help the company meet its target of procuring at least four per cent of total energy purchased from renewable sources. This is as per the mandate set out by the ministry of new and renewable energy (MNRE) whereby each power distribution utility that purchases power from others has to procure at least four per cent of the total energy from renewable sources. CEO of NPCL, RC Agarwala said that they are trying to generate as much renewable energy ourselves through captive solar power plants instead of purchasing power from outside. They have set the target of producing 1 MW solar power within a span of two years.

In subsequent phases, NPCL would engage in community distribution of solar power through women self-help groups. Solar power would be distributed, on a cost basis, through women self-help groups which are being built in villages in Greater Noida as part of another programme in association with a Delhi-based NGO, Development Alternatives.

A project to run all its offices and substations on solar power is already underway by the NPCL. Under this project, six offices and six substations of the NPCL in Greater Noida will run on solar power. The energy that would be saved by running its own utilities on solar power would be diverted for the use of consumers. "Since Greater Noida is a rapidly developing city, the number of consumers is growing with each passing day. Power thus saved can be diverted for consumers' demands," said Agarwala.

The MNRE provides a flat rebate of around 28-30 per cent for setting up these systems., Each system would cost around Rs 22 lakh to the company after discount.

Source: http://articles.timesofindia.indiatimes.com/2011-10-29/delhi/30336173_1_solar-power-renewable-energy-npcl

3 Aston to Shape the Future of Bioenergy Projects

A business blueprint for bioenergy is being developed by Aston University, UK through an innovative partnership with a leading renewable energy developer.

Academics and researchers at Aston Business School and Aston School of Engineering and Applied Science, are collaborating with Enco Energy Ltd and the Economic and Social Research Council (ESRC) to create a complete risk management tool for bioenergy project development. This blueprint is designed to ensure any new biomass schemes have a rigorous business model in place to ensure continued success for renewable energy schemes in the UK.

Enco Energy Ltd. is a developer and owner of small-scale biomass combined heat and power (bCHP) schemes in the UK. Formed in 2007 to exploit the extensive opportunities in bCHP generation, the Norfolk based company's unique business model and extensive experience in the industry has given them a strong foothold in this rapidly growing sector.

The risk management model, which is being developed by Aston PhD student Daniel Wright, uniquely utilises a 'fuzzy logic' approach to increase the efficiency and effectiveness of analysing and managing the risk inherent in potential bioenergy projects. This process involves a detailed understanding of a potential project's viability and risk exposure throughout its lifetime, to greatly reduce predevelopment time and continued and future costs.

The model is also tailored specifically to bCHP schemes and incorporates project stakeholder expertise to analyse potential technological, economic, social, and environmental risks. The project draws on expertise from both Drs. Prasanta Dey of Aston Business School and John Brammer of the School of Engineering and Applied Science.

Dr Prasanta Dey, principle investigator of the project, viewed that the multiple criteria-based decision support system, will identify risk events, analyse their effect and help make decisions in every stage of project with the involvement of concerned stakeholders. This would be a completely new application of fuzzy multi criteria decision-making tools in the bioenergy industry. It is an approach which I believe fosters the best possible opportunity of business success for the developer." He also added that Aston Business School's partnership with Enco emphasises the benefits of interdisciplinary collaboration and knowledge sharing to excel performance and leadership in both academia and industry. It is hoped that this pioneering research project is the first of many with Enco and the vitally important bioenergy sector.

Source: http://www.thebioenergysite.com/news/9849/aston-to-shape-the-future-of-bioenergy-projects

4 ICM branches into biomass

Ethanol company ICM has decided to branch off into the waste-to-energy sector, opening a demonstration plant in Harvey County, Kansas in the US.

The facility uses a gasifier, which is running at full capacity on various types of feedstock, such as municipal solid waste and producing syngas. The unit has the potential to produce electricity and thermal energy if it receives the investment required to purchase more equipment.

Different feedstocks have already been tested on the gasifier, such as wood chips, wheat straw, switchgrass and corn stover.

Although not yet operating at a commercial scale, ICM says the plant has the potential to produce 4-5MW a day, powering between 5,500 and 6,200 homes.

'The facility could move to a nearby land fill site that has already been closed and so we could use the transfer centre which is already set up with the sorting and recycling facilities,' Jon Orr, who is responsible for business development in the gasifier product area for ICM, told Bioenergy International. 'It has the potential to connect to the nearby grid through the substation.'

About two years ago ICM received a grant from the Kansas Bioscience Authority (KBA) Matching Fund program award of $500,000 (€365,500) for the research and testing of its Biomass Gasification System. In the project, ICM funded more than a 10-to-1 match that included infrastructure, testing, and operational expenses to commercialise its proprietary biomass gasification.

In 2009, ICM began operating its commercial-scale demonstration gasifier with the capacity to convert 150 tons per day of biomass and create a syngas (producer gas) at another site. Since then more than 13 feedstocks have been tested, and 7,000 tonnes of multiple feedstocks processed.

For the new facility, ICM is working with Eisenmann for the use of its Wesp technology, a multi-pollutant control system.

Source: http://www.bioenergy-news.com/index.php?/Industry-News?item_id=4155