Ministry of New and Renewable Energy
Government of India

सत्यमेव जयते

ISSUE 3 – MAR 2010

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. Published by Winrock International India (WII)

DIREC 2010

Delhi International Renewable Energy Conference 2010

27–29 October 2010 • Expo Centre and Mart, Greater Noida (National Capital Region of Delhi, India)

Upscaling and Mainstreaming Renewable Energy for Energy Security, Climate Change and Economic Development

India shall be hosting Ministerial-level Global Conference on Renewable Energy titled: "Delhi International Renewable Energy Conference (DIREC)" on 27-29 October, 2010 at New Delhi/NCR. The conference is a part of an initiative taken at the 2002 World Summit on Sustainable Development in Johannesburg, acknowledging the significance of renewable energies for sustainable development especially for combating poverty and for environmental and climate protection.

The Delhi conference is the fourth in the series, following events at Washington in 2008, Beijing in 2005 and Bonn in 2004 and is expected to be the premier all-Renewables gathering in India ever, with an attendance of over 9,000 delegates, over 250 industry leading speakers, experts, academicians, Government leaders, financial institutions and around 500 exhibitors from all over the world, which will make it the largest event of its kind.

DIREC 2010 aims to showcase India as an investment destination for renewable energy; to provide a platform for technology displays, new applications and innovations; to display global research & development with respect to climate change and green environment; to demonstrate the sectoral strength of the global renewable energy industry; and to facilitate: (i) buyers and sellers matching (ii) one to one meetings for setting up of joint ventures in the renewable energy sector and (iii) to provide an opportunity to Indian renewables manufacturers to benchmark their products against the best in the world and enhance their competitiveness. The Conference will ultimately lead to renewed commitment, with concrete proposals in support of activities at the country level.

The DIREC 2010 will build on the success of the previous conferences and have as its main theme "Upscaling and Mainstreaming Renewables for Energy Security, Climate Change and Economic Development". REN21- the Renewable Energy Policy Network will be a key partner in the DIREC 2010. Cabinet-level government functionaries from a number of countries will join civil society partners and private sector leaders to discuss the opportunities and challenges of a global, rapid deployment of renewable energy. The conference will bring together ministers, high-level decision makers and policy level thinkers from a number of participating countries. DIREC 2010 offers industry leaders the ability to share their insights, strategies, technologies, new products and staff capabilities with their audiences.

For further details, visit

www.direc2010.gov.in

Organized by

सत्यमेव जयते

Ministry of New and Renewable Energy
Government of India

Supported by

REN21 Renewable Energy Policy Network for the 21st Century

Managed by

Ei

Exhibitions India Group

MESSAGE FROM THE EDITOR

It is a pleasure to know that our readers have enjoyed reading the first two issues of "Bioenergy India". We are attempting to make it more useful and relevant in the backdrop of the relevance of biomass as an energy source in India, particularly for the rural population. Efficient utilization of biomass both for energy and power can offer a range of benefits, including opportunities for better livelihoods of rural population. A comprehensive approach to promote efficient biomass based energy systems and use of biomass for power generation in a sustainable manner can contribute to the Government's aim to provide 'electricity to all' by 2012. There are, however, several barriers in realizing this objective. The ongoing UNDP-GEF Project specifically aims at identifying such barriers to promotion of large-scale deployment of various biomass conversion technologies for power generation. Lately, biomass gasification technology for power generation is emerging as a possible solution for production and distribution of electricity in the rural areas based on a viable business model. For this issue of Bioenergy India, we have chosen topics of biomass gasification based distributed power generation in the rural environs and emerging manufacturing capabilities of producer gas adaptable engines.

The previous issues contained information about the possible gains through installation of bagasse cogeneration facilities in sugar mills. However, such facilities were making commercial sense in large sugar mills of more than 2,500 tonnes crushing capacity per day. Under the UNDP Project, a study was therefore conducted to address the issues and challenges confronting establishment of optimum bagasse cogeneration systems in smaller sugar mills. The results of the study have been included in this issue. Indian Renewable Energy Development Agency Limited has played a pioneering role in supporting biomass power and cogeneration projects in the country. A brief account of their activities appears in this issue.

Budgetary allocation for the renewable energy sector is seeing substantial enhancements. The solar energy sector is witnessing unprecedented activity geared to larger deployment of solar energy based applications with the Jawaharlal Nehru Solar Mission occupying centre-stage. This could perhaps herald the mainstreaming of renewables, where the biomass power and cogeneration sectors could be important contributors.

I impress upon all our readers to share the views and experiences which would enable us to present the successes and failures of this key sector.

(K.P. Sukumaran)

National Project Manager
(UNDP Project on Access to Clean Energy), and
Former Adviser, MNRE

Tracing the trends in Budgetary Allocations for the National Bioenergy Program

Various renewable energy technologies like solar, wind and biomass, etc, have been developed and deployed in order to build environmentally benign energy systems. The obvious purpose is to augment the national energy supply. To begin with, the financial commitment for utilization of such resources has not been easy to come by. It can be simply gauged from the fact that between 1980 and 1992, the cumulative Government of India expenditure in the renewables sector totaled Rs 1,155 crore. In comparison, the Government invested more than Rs 81,200 crore in the power sector, Rs 33,500 crore in the petroleum sector and Rs 15,850 crore in the coal sector during the same period. In the 8th Plan (1992-1997), the allocation for the renewable sector was a mere 0.8% of the total budget for the energy sector. For this year i.e. 2010-2011, the Government more than doubled the plan allocation for power sector to Rs 5,130 crores from the previous Rs 2,230 crores for 2009-2010. Such an allocation does not include allocations made separately under the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY).

However, the state of affairs is now changing for the better as evidenced by the subsequent plan allocations for the renewable energy program in the country. The 2010 budget clearly acknowledges renewable energy as a credible strategy for combating global warming and climate change. The approved outlay of the Ministry of New and Renewable Energy (MNRE) for 2009-2010 was Rs 620 crore (GBS), which has now been enhanced to Rs 1,000 crore (GBS) for the period 2010-2011. It thus represents an increase of 61% over the last year's outlay. The Ministry aims to achieve various targets in the next fiscal, which includes ensuring 2,972 MW grid-interactive power capacity. Our existing focus is on the bioenergy program, which can be genuinely regarded as an indigenous effort in terms of technology development, upgradation, application innovation and market dissemination, etc. In the first phase of this country wide program, heightened impetus was witnessed for the small woody biomass gasifiers mainly for water lifting applications by powering small diesel engines of 5 HP and 10 HP ratings. Around 1,000 gasifier systems were installed in the late eighties and early nineties under the ambit of a highly subsidized scheme. The existing phase of the bioenergy program took off in the early 1990's with a strong preference for other applications of gasifiers i.e., power generation via dual-fuel operation of diesel generating sets in addition to a range of thermal applications and development of higher capacity gasifiers etc. The Ministry support for the application packages was raised from Rs 67 lakh in 1989-1990 to Rs 166 lakh in 1990-1991. The R&D component too registered a definite increase from Rs 63 lakh in 1989-1990 to Rs 68 lakhs in 1990-1991. The non-woody biomass gasifier specific percentage allocation went up to 22.14% as against 7.23% share for the woody biomass based systems. The resultant outcome of various initiatives in this direction saw the emergence of biomass gasifier systems in the power range of 100-300 kWe and above in the subsequent years.

The 9th Plan (1997-2002) revised estimate for the biomass power/cogeneration was Rs 63.75 crore as against actual expenditure of Rs 74.50 crore during the same plan period. Likewise, these figures for the biomass gasification program for the same period were Rs 14.50 crore and Rs 14.61 crore respectively. The 10th Plan (2002-2007) approved outlay for the biomass power/cogeneration almost doubled to Rs 125 crore, while as it was Rs 35 crore vis-à-vis the biomass gasification. The total proposed outlay to achieve a capacity addition of 14,000 MW worth grid interactive renewable power (comprising of wind power, small hydro power, biomass power/cogeneration and waste to energy based power) during the ongoing 11th Plan (2007-2012) is Rs 1,800 crore. Out of this, the proposed outlay for the biomass/cogeneration sector is around Rs 800 crore i.e. 44.5% of the total outlay. Likewise, the proposed outlay for bioenergy related research, design and development (RDD) initiative is Rs 150 crores as against Rs 200 crores for the RD&D component of wind energy.

It is in the fitness of things to mention here that budgetary support of the above mentioned nature has helped to achieve a cumulative grid interactive biomass power (agro residues)/cogeneration (bagasse) capacity of 2,136.50 MW as on December 31, 2009. Apart from that, 210.57 MW capacity of off-grid biomass power/cogeneration (non-bagasse) has also been achieved by the end of 2009. The biomass gasifier installations with an aggregated capacity of 109.62 MWe also owe their origin to the Ministry's efforts in this direction. Expectedly, the coming years may see a whopping increase in the budgetary allocations for the bioenergy sector keeping in view the large potential still waiting to be tapped for several energy end-use considerations.

EDITORIAL OFFICE
Project Management Cell
Ministry of New and Renewable Energy
Block No. 14, CGO Complex,
Lodi Road, New Delhi 110 003
Telefax : 011-24369788
Website : www.mnre.gov.in
Email : jainvk@nic.in

सत्यमेव जयते

PRODUCED BY
Winrock International India (WII)
S-212, 2nd Floor, Panchsheel Park
New Delhi – 110 017
Tel: 91-11-26013869; Fax: 91-11-26013876
Website : www.winrockindia.org
Email : wii@winrockindia.org

PRINTED AT
Printer : Premier Fime P P Ltd, New Delhi
Publisher : Ministry of New and Renewable Energy, New Delhi

contents

Universal Biomass Energy – A Fuel Linkage Model

"With its array of gadgets and machines, all powered by energies that are destructive of land or air or water, and connected to work, market, school, recreation, etc., by gasoline engines, the modern home is a veritable factory of waste and destruction. It is the mainstay of the economy of money. But within the economies of energy and nature, it is a catastrophe. It takes in the world's goods and converts them into garbage, sewage, and noxious fumes-for none of which have we found a use." – Wendell Berry

Biomass as Energy Security Paradigm

Although Wendel Berry's criticism of gadgets and machines cannot be ruled out completely, but with the use of renewable energy options the possible harmful effect can certainly be curtailed. With this backdrop the article, "Case Study of Universal Biomass", attempts to present before the readers challenges, strategies and allied aspects of commissioning and operation of a Biomass Plant, which is among the biggest plant set up recently in India in terms of power capacity generation. The promoters opted for a biomass based power plant to use the huge agricultural waste available in the area, which otherwise is burnt in fields after harvesting, causing serious health hazards and adverse environmental impacts. This project aims to check the environmental degradation in the region, reduce health hazards besides improving the financial and social status of people, especially farmers and laborers.

Project at a Glance

Universal Biomass Energy Pvt Ltd is an Independent Power Plant (IPP) of 14.5 MW capacity jointly promoted by Awlas, a business family of Guruharsahai and Badals, agriculturists from Badal village. The plant is located at village-Channu in Muktsar district of Punjab and covers an area of 13 acres. Daily fuel consumption is around 400 MT (approx) at full load. The water requirement for the plant is met from the Sirhind feeder through an underground pipeline to a water reservoir provided at the plant. With 14.5 MW installed capacity, around one crore units of electricity are exported to the state grid (PSEB) at the 132 KV system at Gidderbaha sub station, in one month.

Union Minister for New and Renewable Energy, Dr Farooq Abdullah with Punjab Deputy Chief Minister, Sukhbir Singh Badal at the inauguration of the biomass power plant at Muktsar

How it all Started

Biomass[1] has always been an important energy source in India. Current energy scenario in India reflects a growing dependence on conventional forms of 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.

The Muktsar project is inspired by the success of the 50 tonne rice mill project in Gazipur, Uttar Pradesh which was commissioned 2 years ago by the promoters. A 14.5 MW capacity biomass plant was commissioned in Gazipur with the intention of using the husk generated from the rice mill. After assimilating the learnings from the first experiment in the Gazipur plant, the Muktsar project was conceptualized as an IPP. This was done primarily to avoid the dependence on one biomass fuel, which, in the Gazipur plant, was rice husk.

Before initiating the project, a biomass resource assessment study was conducted to identify the biomass potential in the Muktsar region. This study predicted a large biomass potential of paddy straw, mustard husk and cotton straw in the region. Convinced with the potential, the promoters went ahead for commissioning the plant. Therefore the plant was designed to incorporate multiple fuels in the boiler. The power plant was commissioned in a record time of 14 months, almost five months before its planned schedule.

The Technology

This plant is basically a traditional thermal power plant based on Rankine cycle but the fuel used is agricultural waste and wild growth in place of fossil fuel. At Universal Biomass Energy Pvt. Ltd, Channu, the installed equipments are of state-of-the-art technology procured from internationally renowned manufacturers and conforming to the latest standards of technology and safety.

Boiler: The boiler is of 70 TPH capacity with 67kg/cm^2 pressure steam at 475+/- 5^0 C. The furnace is of Travelling Grate type with high combustion efficiency on multi-biomass fuels. The designed efficiency is 76%. The operation of the boiler is through DCS control incorporating all major control loops for easy, fast and safe operations.

Turbine: The turbine is of condensing type and the Turbine-Generator set is capable of generating 14.5 MW at 11 kV, 50 Hz, 0.8 power factor at generator terminals.

Cooling Tower: The cooling tower installed is of 4,500m^3 capacity having three cells and capable of cooling water from 42^0 C to 32^0 C. This RCC structured induced draught, counterflow cooling tower has splash type fill along with PVC drift eliminators and is designed at wet bulb temperature of 27^0 C.

Conveyor system of the plant

The turbo generator is synchronized with the grid, through 11 kV STG incomer by monitoring the voltages, frequencies and phase angles of both the systems. Various energy saving equipments have been installed to reduce auxiliary power consumption.

For feeding biomass fuel to the boiler, a conveyor system consisting of main belt conveyor (BC-1), chain carrier, return belt conveyors (BC-2&3) of 20 MT/hr capacity each have been provided.

To avoid fire incidents at the plant, water based hydrant systems have been provided in the fuel yard, various boiler floors and ESP area. In offices, cable gallery and MCC rooms, portable fire extinguishers have been provided.

Strategic Issues and Challenges

Establishment of a project at such a scale, particularly in renewable energy is in itself a mammoth task. Promoters were faced with several strategic issues and challenges. This section succinctly describes the key issues which emerged and how these were tackled.

Biomass Availability

The study predicted very high biomass potential in the region, however all of that did not translate into reality.

> *"The methodology used for prediction of biomass is more of a theoretical nature which takes into account the productivity and land use. Practically we found that the available biomass is very less, which was a big setback to us. Two key reasons for the huge gap between the prediction and the real outcome are the high moisture content in the biomass and the improper accounting of current usage of biomass by local populace."* – Official, Universal Biomass Energy

Cotton stalk was proposed to be the major biomass, which was to be mixed with alternate biomass fuel which includes mustard stalk, rice straw, wheat straw, wood chips, etc.

Fuel Linkage

As evident, collection, storage and processing of biomass for feeding into the power plant is a complex exercise, calling for prudent logistics management. Universal Biomass came up with an innovative method for ensuring smooth collection of biomass. They have established

One of the biomass collection centre of the plant

collection centers at strategic locations within 50 km proximity. Each of these collection centers, to avoid fixed investment, are taken on lease and are spread in an area of 7-8 acres. In the first year, after the plant was operational, it was realized that the number of collection centers (which act as the backbone of an effective fuel linkage system) need to be increased significantly. According to officials at the plant, the total number of collection centers spread over nearby villages and even in nearby districts, it needs to be almost tripled so as to make the supply system more effective. Currently there are 12 collection centers in operation, which company intends to increase to at least 50 in the coming year. However, increase in number of collection centres will lead to considerable direct increase in the cost of production. This is where the Government needs to take initiatives so as to ensure hassle free deployment of such large-scale projects.

The basic idea behind increasing the number of collection centres is to maximize the utilization of the available resources and most importantly, to ensure a constant flow of fuel. However, the collection centers are prone to fire hazards. Therefore this calls for infrastructural investment for establishing fire safety centers in each storage unit. Universal Biomass is yet to come up with a strategy to establish these.

Operational Aspect

Even though this power plant is designed for multi-fuel firing, there are some inherent issues in usage of individual biomass residues which hinder smooth operation of the power plant. Key issues which promoters have faced till now, with respect to biomass are:

- Utilization of rice straw as renewable energy source has attracted increasing interest[2] since the past two decades. There are certain attached nuances with paddy straw which are its low heating value, low bulk density and significant amount of alkali and alkaline compounds. These create difficulty in handling, transport and storing efficiently, hence, limiting the commercial use of rice straw. Moreover, chlorine which is released during burning damages the boilers. A major hurdle with respect to the utilization of rice straw for chemical and energy production is the associated costs and logistics of collecting, transporting, handling and storage. Straw contains silicon oxide (SiO_2) which could result in high quartz ashes that can cause erosion problems in the convective pass of the boiler and handling systems. These properties have negative impacts during energy conversion such as lower combustion efficiency and performance, high wear and maintenance for processing equipments and can cause operating problems that affect the boiler/ furnace reliability and operating cost. Straw fuels have proved to be extremely difficult to burn in most combustion furnaces, especially those designed for power generation, due to the rapid formation of deposits (Baxter et al., 1996). Such deposits retard the rate of heat transfer, slag formation in the furnace and on grates hinder fuel feeding, combustion and ash removal and handling (Baxter, 1993; Jenkins et al, 1998). These problems increase the cost of generating power from low quality fuel because they reduce the facility's efficiency, capacity and availability. In the operation of the plant, it was observed that it is not possible to use more than 15% paddy straw in the mix. It needs to be mixed in the following ratio:

Cotton stalk	60-70%
Mustard stalk	15-40%
Other biomass fuel	1-10%

- Quantity of mustard straw, which is required for the plant, is not available in the vicinity. Therefore, it is being imported from neighboring states of Haryana and Rajasthan because of which transportation costs have increased considerably, as against what was planned earlier in the cost calculations.
- Harvesting of cotton happens only in the period of November-December, so the procurement for the entire year has to be done within these two months. Due to this time constraint, most of the cotton straw which is purchased has high moisture content, at times more than 50%. Therefore, almost double the amount of the actual requirement of cotton straw has to be collected. This clearly translates into massive storage

requirements resulting in an overall increase in logistics costs as against the planned costs.

Benefits of the Project

Key benefits which have percolated from the project are enumerated below:

Direct Benefits

Clean energy fed into the grid: Among the biomass based projects installed till date in Punjab, this project has the biggest capacity. Inspite of issues of shortage of biomass, use of fossil fuel has been completely avoided by the management and 100% biomass is being used for feeding the boiler. As per the buy back agreement with the state electricity board, the entire power generated will go directly to the grid for the next 20 years

Increased income levels of farmers: According to the plant authorities, almost 60% of the total revenue is pumped back into the economy which in turn has enhanced the economic conditions of the farmers greatly. Farmers in the region are a happy lot for the simple reason that they are getting paid for something that they would otherwise burn and waste. At the most they could use some of it as cooking fuel, which anyway causes severe health hazards.

Landless labour at work in one of the collection centers

Employment generation: Apart from farmers being paid for the waste generated, even the landless laborers have found employment opportunities in the storage centers, which require manual labor for chipping the straw.

Indirect Benefits

Regular cleaning of canals/water drain: Interestingly, with the establishment of the power plant, all the storm water drains in the nearby region have got a fresh life. Landless laborers cut the elephant grass and sell it to the power plant for which they get returns. This additonal financial benefit has indirectly contributed to the cleaning of canals/drains which otherwise used to be choked.

Success Story

Kulwant Kaur (3rd from left) at one of the collection centers

Kulwant Kaur of Channu village in Muktsar district of Punjab has spent most of her life on farm lands. She owns a small farm where she grows rice and earns her livelihood. But her life is changing slowly for the better. In the last five months, she has earned Rs 5000 a month which is double the amount what she earned before the Universal Biomass Plant was set up. The smile refuses to fade from Kulwant's face who is now planning to get her daughter married like a princess. She says, "Earlier my earnings would be limited to the produce of my farm land but now after the plant has been set up, I not only earn from selling husk generated out of the produce but also work as labor where chipping of the straws and husks is carried out. So both ways it's been a win-win situation for me." And Kulwant is not the only one; there are many others in the nearby villages who have started feeling the strength of economic empowerment.

LPG connection: As a CSR activity, the management is actively pursuing LPG agencies to open their centers in the vicinity of villages which are supplying biomass. People are getting remunerative returns for their biomass and therefore they now have the financial capacity to purchase the LPG cylinders. Moreover, use of LPG as cooking fuel will improve the health of women and reduce cases of various respiratory diseases which are quite prevalent in the area.

Spread of fire: Before this project came up, farmers used to burn the residue in the field, even though it was declared illegal by the court. This often led to spread of fire and loss of property. Now, since farmers get remunerative returns for their biomass residue, they are not burning it in their fields.

Byproducts: The plant produces about 50-60 MT of fly ash daily. For removal of ash from the ash hopper, riddling hopper & economizer / air heater hoppers, submerged type belt conveyers with screw conveyers have been provided. The ash from the ESP hoppers is being collected through a screw conveyor of 5MT capacity which is discharged directly into the tractor trolleys. The ash thus collected is being used for preparation of construction bricks. The management is now planning to commission a cement plant as fly ash is one of the key ingredients in manufacturing of cement.

Future Challenges

The management is satisfied with the current functioning of the power plant; however there are certain issues which cause worry. The biggest challenge lies in cost effective procurement of biomass.

> *"The power plant was synchronized in October 2009. For the operational needs of the first two months, biomass fuel was stored in-house. This enabled the plant to run at full capacity and plant load factor (PLF) at 90% capacity was achieved. Due to reasons mentioned above and the problem of inadequate fuel supply, power generation was badly affected. As a result PLF has reduced to 60-70%. The management is trying to improve the fuel linkage by expanding the network of collection centers, in order to achieve the 90% PLF."* – Official, Universal Biomass Energy

The management becomes apprehensive if nearby industries start using biomass for their operations, as their efforts for synchronizing the biomass collection would be in vain because biomass may not be available in the proximity. This fear is born of the fact that nearby paper mills have already started using biomass for their operations.

References

1. http://www.nri.org/projects/biomass/conference_papers/policy_annex_2.pdf
2. http://www.academicjournals.org/ajar/PDF/pdf%202009/Dec%202/Kargbo%20et%20al.pdf

Courtesy: *WII Editorial Team with support from Universal Biomass Energy Pvt Ltd.*

Major Events

Biofuels International Expo & Conference, Barceló Hotel, Czech Republic
May 5-6, 2010
For details: Margaret Garn
(Margaret@biofuels-news.com)

BSI Bioenergy Conference
May 18-19, 2010
CBI Conference Centre
London, GREATER LONDON GB
For details: http://shop.bsigroup.com/Bioenergy

World Bioenergy 2010-Conference and Exhibition
May 25-27, 2010
Johnkoping, Sweden
For details: Mr. Gustav Melin
(worldbioenergy@svebio.se)

64th International Convention of the Forest Products Society
June 20-22, 2010
Monona Terrace Community & Convention Center
1 John Nolen Drive
Madison, WI 53703 US
For details: http://www.fpsconvention.org

5th Asia Clean Energy Forum 2010
June 22-25, 2010
Manila, Philippines
For details: Samuel Tumiwa (stumiwa@adb.org)
Peter du Pont (peter@cleanenergyasia.net)

Cleanpower2010
June 25, 2010
Murray Edwards College, Huntingdon Rd
Cambridge, CAMBRIDGESHIRE GB
For details: http://
www.cambridgeinvestmentresearch.com/events/

AEBIOM European Bioenergy Conference and RENEXPO
June 29-30, 2010
Brussels, Belgium
For details: Mr. Jossart Jean-Mark
(jossart@aebiom.org)

Scheme for Implementation of Grid interactive Biomass Power and Bagasse Cogeneration Projects

Biomass for generation of distributed grid quality power, both from captive and field biomass resources has been attaining progressive attention across the globe. The technologies are getting progressively up-graded with each passing day and commercialization is in the offing, although stiff challenges of various barriers still are perceived, particularly for grid quality power from biomass materials. The Ministry of New and Renewable Energy focused attention on this sector since beginning of the 9th Five Year plan i.e. 1992-97. A host of innovative measures and serious efforts have been put in by this Ministry to attract investment in this sector and create awareness amongst the stakeholders. The Ministry has recently announced a scheme for implementation of grid interactive biomass power and bagasse cogeneration projects.

The scheme provides for subsidy to projects for setting up biomass combustion based power projects and bagasse cogeneration projects in private/cooperative/ public sector sugar mills. This scheme modifies earlier schemes relating to grid interactive renewable power generation projects based on biomass combustion and bagasse cogeneration and will be applicable from 1st April, 2010 and will continue up to the end of 11th Plan period i.e. 31 March, 2012. The main focus of the scheme is:

- To promote setting up of biomass power projects with minimum steam pressure configuration of 60 bar and above for surplus power generation (grid interfaced on commercial basis).
- To promote cogeneration projects for surplus power generation from bagasse in private/cooperative/public sector sugar mills with minimum steam pressure configuration of 40 bar and above (Grid interfaced on commercial basis).
- To promote bagasse cogeneration projects for surplus power generation in cooperative/public sector sugar mills with minimum steam pressure of 60 bar and above, taken up through BOOT/BOLT model by IPPs/ State Government Undertakings or State Government Joint Venture Company (Grid interfaced on commercial basis).

According to the scheme, the subsidy for private sector projects, viz., IPP Grid interactive biomass combustion power projects and bagasse cogeneration in private / Joint sector sugar mills, IPP based BOOT/BOLT model projects in cooperative / public sector sugar mills will be released after successful commissioning, and commencement of commercial generation and testing of the project (back ended subsidy). However there will be an exception in the case of bagasse cogeneration projects in cooperative/public sector sugar mills implemented by State Government Undertaking / State Government Joint Venture Company/SPV Company (Urja Ankur Trust) through BOOT/BOLT model and cogeneration projects by cooperative / public sector sugar mill themselves, wherein 50% of eligible upfront subsidy will be provided and the balance 50% will be released after successful commissioning and performance testing of the project.

In order to facilitate the SNAs, Developers, Manufacturers, Investors and State Electricity Boards to have transparent information on the implementation of grid connected biomass power projects and its healthy and orderly growth, certain guidelines have been issued with focus on availability of biomass, capacity of projects and selection of sites, availability of water, grid interfacing, establishment of fuel supply linkages, use of certified equipments, use of conventional fuel and submission of detailed project reports (DPR).

The draft guidelines have been prepared based on the experience of the Ministry in implementation of the program and also in consultation with various stakeholders including Associations of Biomass Power Plants. Consultation with the State Governments is currently under process for finalization of these guidelines and is expected to be over by end of May 2010. For further details related to eligibility criteria, subsidy plans and other additional information, please contact:

Dr JR Meshram, *Director, Biomass and Cogeneration, Ministry of New and Renewable Energy*
Block No 14, CGO Complex, Lodi Road, New Delhi
Email: jrmeshram@nic.in; Tele/Fax No. 011-24365666

Overview of Small Sugar Mills and Barriers for Bagasse Cogeneration

Status of Small Sugar Mills in India

It is estimated that a total of 576 sugar mills are operating in India today. These sugar mills have capacities ranging from as low as 500 TCD to as high as 10,000 TCD. In 1982, the Ministry of Food and Agriculture, Government of India, established minimum economic capacity criteria of 2,500 TCD for new sugar mills based on economic viability. Notwithstanding the above guidelines, about 156 sugar mills, as on date, have capacities below 2,500 TCD.

As can be seen from Figure 1, out of a total of 576 sugar mills, 420 mills (73%) have capacity of 2,500 TCD or above. The mills above 2,500 TCD mainly fall under the private sector with crushing capacity in the range of 2,500 TCD to above 10,000 TCD, which are characterized by modern and state of the art technologies for sugar production, high energy efficiency, plant automation & control and integrated with advanced cogeneration and bio-ethanol production facilities. The technical and financial performance of these mills is far superior compared to the mills below 2,500 TCD.

Out of 576 sugar mills, 28 mills, accounting for 5%, are very small in size with capacity below 1,250 TCD. These are mainly in the cooperative and public sector and the financial as well as technical performance of these mills are very poor.

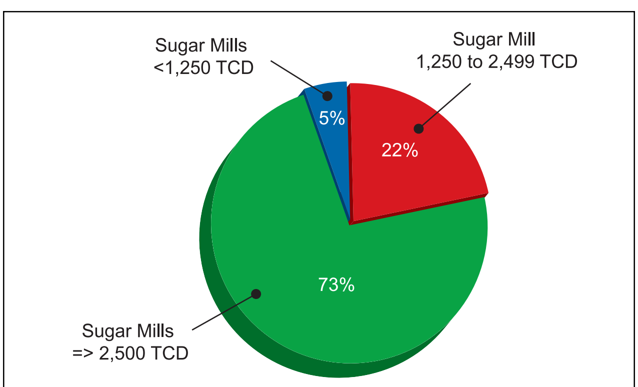


Figure 1: Capacity-wise account of all sugar mills in India

As on date, there are 128 sugar mills falling in the 1,250 to 2,499 TCD capacities, accounting for 22% of the total.

The distribution and profile of 128 mills by state, sector, and capacity along with their cogeneration status, is discussed in the following sections.

Geographical Distribution of Sugar Mills

Sugar mills of 1,250 to 2,499 TCD are spread over the entire country, across all the four regions. However, a majority of these mills are concentrated in seven states viz. Maharashtra, Uttar Pradesh, Karnataka, Andhra Pradesh, Punjab, Haryana, and Tamil Nadu. The regional and state-wise distribution of these mills is shown in Table 1.

Table 1: Regional and state-wise distribution of sugar mills of 1,250 to 2,499 TCD

State	Number of Sugar Mills
Northern region	
Uttar Pradesh	15
Haryana	6
Punjab	6
Madhya Pradesh	3
Uttarakhand	1
Total	**31**
Western region	
Maharashtra	59
Gujarat	3
Goa	1
Total	**63**
Southern region	
Karnataka	14
Andhra Pradesh	8
Tamil Nadu	5
Puducherry	2
Total	**29**
Eastern region	
Orissa	3
Bihar	1
Assam	1
Total	**5**
Grand Total	**128**

Source: *List of Cane Sugar Factories & Distilleries, STAI (2007-2008)*

It can be observed from Table 1 that the western region has the largest number of sugar mills (49%) followed by the northern region (24%) and southern region (23%) respectively. The eastern region has a negligible concentration (4%) of mills. However, its the states of Maharashtra, Uttar Pradesh, Karnataka, and Andhra Pradesh that account for 75% of the total number of sugar mills. The percentage distribution of sugar mills (1,250 to 2,499 TCD) in major states is shown in Figure 2.

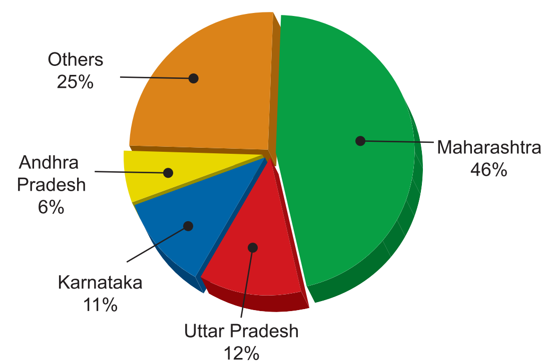


Figure 2: Percentage distribution of sugar mills (1,250 to 2,499 TCD) in major states

Distribution of Sugar Mills by Sector

The sugar mills of 1,250 to 2,499 TCD in India fall under one of the following three categories:

- Cooperative sector
- Private sector
- Government / Public / Joint sector

The sector-wise distribution of sugar mills (1,250 to 2,499 TCD) in India is presented in Figure 3.

It can be observed from Figure 3, out of the 128 mills (1,250 to 2,499 TCD), 98 (77%) are in the cooperative sector; 26 mills (20%) in the private sector; and only 4 mills (3%) in the government / public sector.

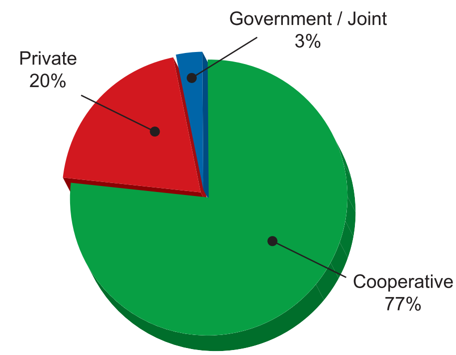


Figure 3: Distribution of sugar mills (1,250-2,499 TCD) by sector

Capacity of Sugar Mills

The capacities of these sugar mills range from 1,250 TCD to 2,200 TCD. The sector, agro-climatic conditions, and cane cultivation practices affect the capacities of sugar mills in this category. Table 2 presents distribution of sugar mills of different capacities

The key observations from Table 2 are as follows:

- About 90 sugar mills (70%) have capacity of 1,250 TCD. The remaining sugar mills are equally distributed among the three capacity groups : (i) 1,300 to 1,600 TCD (ii) 1,700 to 1,800 TCD; and (iii) 2,000 to 2,200 TCD with a share of 10% each.
- Nearly 80% of the 1,250 TCD sugar mills are from the cooperative sector

Status of Industry

Cogeneration

Cogeneration in sugar mills of 1,250 to 2,499 TCD is restricted to production of electricity for captive consumption. Hence, export of surplus power generation to the grid is not prevalent for a variety of reasons.

Table 2: Capacity-wise distribution of sugar mills by sector

Sector	1250 TCD	1300 to 1600 TCD	1700 to 1800 TCD	2000 to 2200 TCD	Total
Cooperative	74	7	5	13	97
Private	16	5	3	1	27
Government / Joint	-	2	2	-	4
Total	**90**	**14**	**10**	**14**	**128**

Source: *List of Cane Sugar Factories Distilleries, STAI (2007-2008)*

Currently, only four sugar mills have cogeneration facilities with a total installed capacity of 12 MW; out of which cooperative sector sugar mills contribute 10.5 MW and a private sector mill accounts for 1.5 MW. The status of bagasse generation in sugar mills of 1,250 to 2,499 TCD is shown in Table 3.

Table 3: Status of cogeneration in sugar mills of 1,250 to 2,499 TCD

State	Installed cogeneration capacity, MW
Maharashtra	8.0
Andhra Pradesh	1.5
Punjab	1.5
Haryana	1.0
Total	**12**

Source: *List of Cane Sugar Factories Distilleries, STAI (2007-2008)*

Technological Status

The technological status of sugar mills (1,250-2,499 TCD) is as follows:

- The cogeneration plants installed in these mills are normally designed to meet the sugar mills' captive consumption of power and steam.
- A steam configuration of 21 ata / 340 °C is employed in these mills and back pressure turbo-generators for power generation. Most of the mills employ 1.5 / 2.5 / 3 MW, 440 volt turbo-generators. The average steam consumption per kWh of these generators is 10 to 12 kg/kWh as against 3.7 to 4.5 kg/kWh in modern turbines.
- A few mills have even lower steam parameters (14 ata / 265 °C or lower) than the above. Such low temperature / pressure steam configurations have the disadvantage of lower power generation per tonne of bagasse.
- The thermal efficiency of such boilers is very low, in the range of 55 to 60%.
- Steam consumption in traditional sugar mills is found to be as high as 55 to 60% as compared to 40% or lower in modern sugar mills.
- The mills produce wet bagasse at 30% on cane with about 50% moisture content. The average gross calorific value of wet bagasse is 2,280 kcal/kg.
- Most of the sugar mills have single stage steam turbine driven equipment with reduction gears, for milling operation.
- Sugar mills have PRDS (pressure reduction and de-superheating station) for throttling steam pressure from 22 bar to 6 bar for use in sulfur burning and sugar drying. Throttling of steam pressure is highly inefficient and results in huge energy losses.

Barriers Against Promotion of Bagasse Cogeneration

There are multiple barriers to the implementation of bagasse cogeneration in sugar mills of 1,250 to 2,499 TCD in India. These barriers exist at different levels, e.g., at the national, state and local level and are often inter-related. This section presents an analysis that aims to collectively bring out the fundamental barriers to the promotion of bagasse cogeneration in sugar mills of 1,250 to 2,499 TCD. The barriers are categorized into technological, institutional, and financial barriers.

Technological Barriers

- **Lack of standardization of technologies:** The high pressure technologies / configurations of cogeneration in sugar mills of 1,250 to 2,499 TCD have not yet been fully standardized, packaged, documented and validated, which creates a significant resistance and reluctance to switch over to high efficiency cogeneration, sugar mill modernization and business models.

View of power turbine of a sugar mill

- **Lack of successful commercial demonstration projects:** There are only a few cases of commercially viable bagasse cogeneration projects demonstrated successfully in sugar mills of 1,250 to 2,499 TCD in India, on a visible scale
- **Limited capacity of sugar mills:** Most of the cooperative sugar mills have a low capacity to implement, manage, and operate grid connected cogeneration based power projects.
- **Lack of trained manpower and operational risks:** Difficulty in availability of trained man power for O & M besides operational risks associated with the utilization of high pressure boilers.
- **Off-season fuel linkages:** The non-availability of sufficient fuel during off season is an important barrier to the promotion of bagasse cogeneration. The risk of inadequate fuel supply is one of the main hinderances.

Institutional / Regulatory Barriers

Institutional and political nature of cooperative mills: The primary barrier to bagasse cogeneration in 1250 to 2499 TCD mills in cooperative sector, is their poor financial health, with many of these mills having defaulted on loans.

Long gestation period: The long project development cycle often acts as a major barrier i.e., the pre-project implementation phase taking more than two years in many projects.

High management risks: Since the cooperative sector is subject to change management every five years, and is influenced by political factors, the risks for bagasse power projects become high.

Lack of adequate policy framework: Different states have different policies that impede the growth of bagasse / biomass power projects. Uncertainties in power purchase rates and insufficient security mechanisms for financial institutions compound this problem.

Irregularities in tariff/payment defaults: The sustainability of bagasse cogeneration project depends on the payment from SEB against the sale of electricity to the grid. The risk inherent in a PPA has been a major factor constraining development of bagasse cogeneration capacity.

The high pressure technologies / configurations of cogeneration in sugar mills of 1,250 to 2,499 TCD have not yet been fully standardized, packaged, documented and validated, which creates a significant resistance and reluctance to switch over to high efficiency cogeneration, sugar mill modernization and business models

Laxity in the implementation of open access for trade in electricity: Except for Karnataka and Maharashtra, where the Electricity Regulatory Commissions have shown innovation in implementing provisions, all other states with substantial bagasse/biomass potential are yet to support open trade in cogeneration power.

Financial Barriers

High upfront cost: The capital investment required is significantly higher compared to the existing incidental cogeneration system, which is based on low/medium pressure cycles.

Lack of financial strength of sugar mills: The profits generated in cooperatives are often distributed by way of additional cane price to the cane farmers leaving no surplus for fresh investments or equity.

Limited access to funds and difficulties in raising equity: Sugar mills below 2,500 TCD are not eligible for availing SDF financing, which is also a big set back for bagasse cogeneration in small sugar mills. The other banks and financial institutions are also not positively inclined to finance projects in bagasse cogeneration for small sugar mills.

Limited interest on investments in bagasse cogeneration: Private sector / other entrepreneurs have difficulties raising loans on existing financing norms due to the perceived high investment risk due to limited number of visibly successful demonstrations.

Courtesy: ***Sobhanbabu PRK,*** *Program Manager and*
CK Kumarswamy, *Program Officer*
Winrock International India, Hyderabad, AP
Email: sobhan@winrockindia.org

Cane Field Residues as Support Fuel for Cogen Boiler at Shri Pandurang Co-operative Sugar Factory

Introduction

Shree Pandurang Sahakari Sakhar Karkhana Limited (SPSSKL) is situated at Shreepur, Taluka - Malshiras, District Solapur, Maharashtra. Previously it was a sick private unit run by the Brihan Maharashtra Sugar Syndicate, established in 1934. It was co-operativised in 1992. The machinery being used at that time was obsolete and inefficient.

The new management in the cooperative sector modernized and expanded the sugar plant to the crushing capacity of 2,500 TCD during the year 1995, in a restructuring scheme. However, as per the then prevailing technology, a new 50 tonnes per hour capacity bagasse fired dumping grate multipass boiler, suitable for 46 ata steam, a 3 MW back pressure TG set and a new milling tandem driven by steam turbine were installed.

Subsequently, the factory installed and commissioned one of the pioneering 9.4 MW bagasse based cogen power plants in the year 2006. Simultaneously, the sugar plant was expanded to the crushing capacity of 3,500 TCD. The cogen plant, installed as a separate unit adjacent to the sugar plant, comprises a 55 tonnes per hour capacity bagasse fired modern design travelling grate multipass boiler suitable for 67 ata steam, an HP heater for heating the boiler feed water to a temperature of about 160º C, a 9.4 MW double extraction condensing TG set and switch yard with the facility to export up to 9 MW power at 132 kV.

Baler collecting Trash

SPSSKL had envisaged achieving full capacity utilization for 270 working days. For that purpose, it had to procure a huge quantity of bagasse during the year 2007-08 at the rate of Rs 600 to Rs 700 per tonne. In view of low cane availability during the season (2008-09) and due to commissioning of cogen power plants at some of the adjoining sugar factories, the landed cost of procured bagasse increased substantially and is presently about Rs 2,500 per tonne. In anticipation of this situation and for ensuring off-season fuel linkage on a long-term basis, SPSSKL decided to explore use of cane field residue as a support fuel for extending the off-season operation of its cogen power plant.

Both the boiler makers were contacted who recommended up to 10% mixing of cane trash with bagasse.

During the season 2008-09, the sugar plant operated at about 4,000 TCD capacity and met its process steam requirement mainly from the 46 ata boiler, through the 3 MW TG set and mill drive turbines, and the rest of the requirement was met from the cogen boiler through controlled bleed from the 9.4 MW TG set.

During the season, the two TG sets generate an aggregate power of 12.1 MW, out of which 3.5 MW is the captive consumption and the rest is exported to the grid.

In the off-season, the cogen plant is operated at part load due to the condenser's size limitation. Gross power generation is about 8.6 MW, out of which 1.3 MW is the captive consumption and the rest is exported to the grid.

Farmers with baled trash

Brief Details of the Biomass Power Project

The Ministry of New and Renewable Energy, Government of India sanctioned Rs 5 crore last year as capital grant under the UNDP/GEF-MNRE project on biomass power and released Rs 2 crore by August 2008. Based on the all round support, SPSSKL proceeded with the implementation of the project involving procurement of machinery, deployment and training of labour and supervisors, etc. Brief details of the equipment and organizational set up for collection, baling, transportation and shredding of the baled trash are as under:

Baling machines

New Holland make model 565 twin rectangular hydraulically operated trash balers (10 Nos) suitable for bale size of 36 cm x 36 cm with adjustable bale length of up to 180 cm and New Holland make model 3630 T X 55 HP tractors (10 Nos) from USA were imported under this scheme. In addition, 4 balers with 4 tractors were also imported at the company's own cost. Thus, 14 sets of baling equipment are now available.

Disintegrator (Shredder) for Bales

Two disintegrators, each driven by a 100 HP electrical motor and having separate trash handling mechanism have been installed.

Organizational Setup

During the season in 2008 – 09, 14 units were deployed to bale and transport trash from the cane fields to the sugar factory site. Each unit comprised (i) one tractor and one baler for baling, (ii) one tractor and two trolleys for transporting the bales from the fields to the sugar factory, and (iii) a team of 12 labourers.

These units perform the following tasks:

- Each tractor owner has been given a baler and thread. He has to carry out routine maintenance of the baler, whereas the expenses on spare parts will be borne by the factory. A 700 gm thread is required to bale a tonne of trash. If less thread is utilized, it is to the economic benefit of the owner and vice versa.
- Transporters, using 2 trolleys, fetch 5 to 5.5 tonnes of trash bales per trip. A rate chart, similar to cane transportation, has been developed and the transporters are being paid 2.5 times the rate of cane trash.
- The team of labourers collect trash in rows and separate out the dry sticks. The same team loads bales into the trolleys.

Estimated Landed Cost of Baled Trash

The following is the break up of the estimated landed cost of baled trash, exclusive of the interest and depreciation on the capital cost, during the season 2008-09:

Baling	Rs 350/- per tonne
Transport	Rs 250/- per tonne
Wages	Rs 200/- per tonne
Royalty to farmers	Rs 100/- per tonne
Total landed cost	**Rs 900/- per tonne of baled trash**

Availability of Trash and Potential Usage

During the season 2008-09, trash was mixed in lesser proportion. Therefore only 9 units were employed, collecting 50-60 tonnes of trash per day. However, each unit has the potential to collect about 10 tonnes trash per day. Every day, 40 hectares of cane is harvested, which has the potential of creating 300 tonnes of trash, i.e. trash availability works out to about 12 tonnes per hour.

Fuel Value of Cane Trash vis-a-vis Bagasse

The bales of cane trash, after transporting from the fields, are stored for over 2 weeks in the bagasse yard before being fed to the disintegrator installed on the belt conveyor which feeds the prepared trash to the bagasse carrier. Samples of the disintegrated trash were sent to a laboratory for analysis. The comparative data on moisture content and calorific value of mill wet bagasse and prepared trash is furnished on the next page:

Fuel	Calorific value kcal/kg	Moisture content
Mill wet bagasse	2,200 – 2,300	48 – 50%
Prepared trash	3,800 – 4,000	10%

Working Results of the Commercial Scale Trials

The details of the energy produced and energy exported along with the amount of cane trash used during the season 2008-09 and off-season 2009 are furnished in Table 1.

Technical Evaluation

After the closure of the cogen plant in May 2009, both the boilers were examined. Heavy slagging was observed on the super heater coils of 46 ata boiler which indicated that this boiler was not suitable for using cane trash as support fuel. However, no adverse impact or slagging was observed in the flue path of 67 ata boiler. It has therefore been decided that in future cane trash be used as support fuel only for 67 ata boiler for in season as well as off-season operation of the cogen plant.

Table 1: Energy Export and Extra Fuel-Yearly Data

Year	Season (kWh)	Off-season (kWh)	Extra fuel
2007-2008	3,91,87,000	2,01,49,000	47,000 tonne bagasse
2008-2009	1,05,74,000	47,00,000	4,414 tonne cane trash
2009-2010	2,39,79,109	—-	7,024.85 tonne cane trash

Table 2: Carbon Credits: Verification Summary

Verification period	July 2006 to March 2008
Net exported MWh	33,008
Total calculated CERs	33,437
Project emission CERs	3
Net CERs	33,434
Issuance request date	24th Jun 2008
Issued CERs	33,434
Issued date	10th July 2008
UNFCCC share as adaptation fund	669 CERs
Project developer share	2,925 CERs
Pandurang share	29,840 CERs
Sale party name	Agrinergy Ltd., London
Sale rate in Euro	20 Euro
Euro exchange rate	Rs. 66.62/- per Euro
Amount issued	Rs. 3,97,56,520/-

Benefits to Farmers

- Saving of expenses incurred in trash burning
- Prevents biological and physical losses of soil
- More earthworm activities improve soil texture
- Left out trash converts into manure and improves soil health
- Good sprouting in ratoon
- Multiplication of nitrogen fixing and phosphate solubilizing bacteria
- Additional revenue on account of money received from sale of trash

contd on pg 30

Multiplier effect of the project on Sugar Cane Trash Utilization at SSK Pandurang: 16 MW bagasse based cogen plant at Yashwantrao Mohite Krishna SSKL (YMKSSKL), Karad, Maharashtra. YMKSSKL is one of the pioneering co-operative sugar factories established in 1960 and has an installed capacity of 7,200 TCD, with 90 KLPD capacity distillery. It was in the year 2007-08 that as a part of phase I, YMKSSKL decided to implement a 16 MW capacity bagasse based cogen power plant. After the necessary permissions as well as ordering for equipment in the year 2009, this plant was commissioned and synchronized with the grid on April 11, 2010, within 15 months from the date of ordering for major equipment and start of the civil works. This is the first project in Maharashtra which has 87 kg/cm^2 pressure and 515 ^{0}C temperature configuration.

The cogen power plant at YMKSSKL is in operation based on saved bagasse and cane trash collected from the sugarcane fields in the command area. As on date, a total of about 25 lakh units have been exported through a trading arrangement with M/s. Tata Power Trading Company Ltd. The plant is expected to operate for another 30 days during off season period. YMKSSKL has purchased Thermax boiler and Shin Nippon TG set. The National Co-operative Development Corporation and Sugar Development Fund have financed this project and MNRE has sanctioned a capital grant of Rs 7.2 crore under its earlier sanction.

Husk Power Systems – Rural Electrification Strategic Business Model

How it all began

"An entrepreneur from Patna, Mr. Ratnesh Kumar joined hands with an engineer Mr. Gyanesh Pandey from the Power Management Semiconductor industry, who had just returned home, leaving behind a lucrative career in Los Angeles, to take the challenge of rural electrification in their home state-Bihar. After years of dabbling with different technologies, they finally zeroed in on the decade old technology of biomass gasification for the purpose. The biomass of their choice was rice husk, the only real waste product in the rural areas where the cycle of life turns such that everything, including human waste, finds some utilization and there is very little that goes waste. With this began "Husk Power Systems"

This case study provides an in-depth analysis of the Husk Power Systems as a business model for rapid replication. A strategic business model framework is used for analysis of "Husk Power Systems". This strategic business model essentially has six components, viz., choice of project area, cost structure of business, market potential, pricing mechanism, strategic relationships and sustainability.

Strategic Location

For any business model to be successful and replicable, selection of project location is most important. This plays a significantly important role, especially when the location provides the benefit of first mover advantage. The case study at hand is a classic case of selecting the strategic location which has provided an extra edge to the viability of the business model. Husk Power Systems, started its operations from "Tamkuha" village which is in the West Champaran district of Bihar. However, due to large basin of the Gandak River, this section of land has remained unelectrified as the State Electricity Board of Bihar has not been able to stretch grid lines to this area. For all practical transactions this village is better connected to Padrona of Kushinagar district in UP. However, since physically this belt doesn't fall in Uttar Pradesh, therefore the State Electricity Board of UP is not expected to provide grid power to this area. From the market perspective, this leaves an open space for an entrepreneur to bridge the gap in electricity services emerging from inability of either of the state governments to provide power to the area. Moreover, this area is particularly known for its rice production, thereby assuring high biomass potential (rice husk). While, this stretch of land, on one hand, is under-served by various agencies including the Government, on the other hand it has a high resource base of biomass for power generation. The choice of location has thus provided a first mover advantage to "Husk Power Systems".

The first biomass power plant of Husk Power Systems at Tamkuha, West Champaran district, Bihar. The plant started operations in August 2007.

Cost Structure of the Business

It is an acceptable fact that till date, renewable energy projects in general and biomass-based projects in particular are not cost competitive compared to fossil fuel-based projects. However, considering the remoteness of the project location chosen by the entrepreneurs of Husk Power Systems, fossil fuel-based grid lines are not expected to meet the demand of the area. Therefore, the only alternative plausible is decentralized power generation either through diesel or renewable energy. The promoters have opted for rice husk based biomass power generation in the aforesaid area with a low cost structure, which is one of the unique features of the project. This cost structure adopted by the promoters has led to an overall lower cost of power generation. The analysis of this low cost structure adopted by Husk Power Systems is important as it can serve as a robust and well tested model for other entrepreneurs. Therefore, in this section a detailed assessment of infrastructure and allied costs is presented.

The Power Plant

Infrastructure for the power plant essentially includes a cement floor, a small hand pump, bamboo walls and "asbestos corrugated sheets" to house the engine and alternator. The land for setting up the infrastructure was taken on lease. In addition to this, a structure made from bamboo with a grass based roof was constructed beside the power plant shed. This area serves as the store-house for 3-4 days of rice husk. The power plant is of 33kW installed capacity and total investment (which includes subsidy from MNRE) is approximately Rs 13 lakh. The expenditure on infrastructure for the power plant shed and storage space is just five percent of the total investment. Thus, it is evident that the project has very effectively minimized fixed investment in the power plant and biomass storage area by using locally available low cost material instead of brick and concrete. It has ensured that on one hand power plant machinery meets the requirement of the power plant and on the other hand is simple and cost effective. Instead of procuring machines from renowned manufacturers, local manufacturers of gasifier and gas engines were approached who had just made an entry into the market.

Power Distribution

Among all existing power plants, where the team from Winrock International India conducted a field visit for this case study, grid lines upto 1.5 km periphery of the power plant have been stretched across the villages. A key feature in the distribution network is the low cost infrastructure, for e.g, the use of bamboo poles at a

The biomass power plant under construction

Locally available bamboo poles are used for power distribution

distance of 15 feet from each other for wiring. The cost of these bamboo based poles is Rs 25 per pole and they are locally available. To avoid electrocution during monsoon, dual insulated cable is used for power supply instead of open wires. Moreover, grid connection from the project covers only the cost of wiring on main route. Customers, who are off route have to take an extension on their own or pay an extra amount for it. With these two measures, the project has minimized the investment in distribution of power to the bare minimum.

Operational Expenses

The power plant provides electricity for 6 hours from evening 6 PM to midnight. Average daily requirement of rice husk is 3 quintals. With the buy back agreement which the project has evolved with the rice de-huskers in the proximity, cost of rice husk is Rs 60/quintal. Therefore, cost of biomass feedstock per month is about Rs 5,500. For managing daily affairs, every power plant has one operator, one electrician and one husk loader. Routine maintenance is carried out by the operator. Apart from these, one person who takes care of husk buying and one electrician are engaged for a cluster of villages. Apportioned expenditure per plant is about Rs 20-25,000 per month. Operators are trained by the project at the in-house training center in Patna for 2 months and then sent for on-the-job training in one of the operational plants.

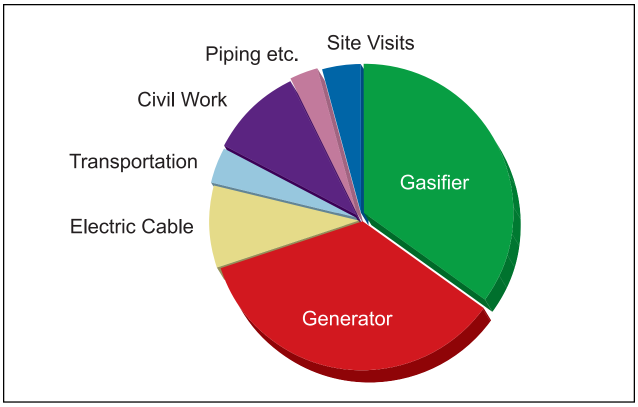


Figure 1: Distribution of costs of the power plant out of total investment of Rs.13 lakh

The distribution of costs for the entire power plant, out of total investment of Rs 13 lakh is exhibited in Figure 1.

Market Potential

The biggest problem which rural electrification projects face is the low payment rate from customers as most of the projects treat energy as a "derived demand", i.e. at an individual or at the community level; people do not need energy but rather the services that it can provide. "Husk Power Systems" has, on the contrary, adopted a "demand driven approach", i.e. they take up only those villages where people are willing, before hand, to take the power connections. Before commissioning of the power plant, a team from the project surveys each household and quantifies the potential demand in Watt-hours. As a thumb rule, only when a minimum 250 households agree to take connections, the power plant commissioning exercise is undertaken. The uniqueness of this agreement approach is that the agreement is not just verbal but an installation charge of Rs 100 per household is collected from the households. This ensures compliance by the users and covers a substantial portion of the grid distribution expenditure thereby further lowering fixed investment by promoters.

Pricing

A differential pricing method is adopted by promoters for electricity charges. At household level, Rs 45 per CFL is the monthly charge. The CFL rating allowed is 15 watts which effectively because of low power factor comes close to 25 watts (Rs 45 is the charge where rice husk is bought from outside the village where as in villages where it is procured are charged Rs 40 per connection). For commercial connections such as in the tailoring shop, sweets shop, etc. the per month charge is minimum Rs 80 and a shopkeeper can use maximum of 2 CFL. Households seeking connections for operating fan/television, etc., are charged on wattage basis. Although the cost of this power is very high, people in the area have still taken the connections and are paying for it due to absence of any other cheaper medium of electricity. However Husk Power System claims that the cost of the electricity is effectively less than what people were paying in alternate fuels such as kerosene.

Strategic Relationships

The operation of any commercial project takes place in the midst of multiple stakeholders which primarily includes raw material suppliers and customers. As discussed above, at the market end, by using a demand driven approach, the project has ensured compliance and pay-back of electricity charges by customers without any hassle.

For the success of biomass based power plants, sufficient and low cost regular availability of biomass is a must. Therefore, the promoters have evolved strong

Dinesh Gupta owns a pan shop in Tamkuha village and is a happy man. He is one of those who took a connection on the very first day, when the plant got operational in 2007. Satisfaction lights up his face as he narrates how his life changed after electricity arrived in the village. He says, "My daily income has gone up to almost Rs 100 per day because now I can keep my shop open till 10 pm. Moreover, my children can study now and even ladies at home find cooking an easier job." He ends up by saying, "Even though the electricity does not come cheap but still I have no complaints".

The story of Rajballam Prasad is a case in point that shows that the company has managed to strike a very strong bond with the rice mill owners, which in turn also ensures a secured fuel supply. On being asked if he would sell his husk at a far higher price to another company, Prasad goes into a denial mode and says, “It’s not just about money. We understand the fact that the company cares for us and so no matter what any other buyer pays, our husk will only find its way to the plant in the village.” Prasad’s strong commitment also finds its roots in the promise that he would get advance money from the company for his daughter’s marriage. Perhaps, it is through these small assurances that the company has managed to walk that extra mile in building a good will image in the region.

relationships with the rice husk suppliers, which is not limited to just a buyer-seller relationship. They have provided insurance coverage of the family members of rice husk suppliers, provided technicians, free of cost, for maintenance of dehusking machines and have a contract agreement of regular purchase at fixed price which is subject to revision annually. The rice husk is transported through tractors that cover about 7-8 plants in one cluster. The job of transportation is handled by a cluster manager in each cluster. The system is working in such a way that while there is purchasing at the micro level, promoters are also working towards signing contracts for bulk supply from bigger organizations like Food Corporation of India.

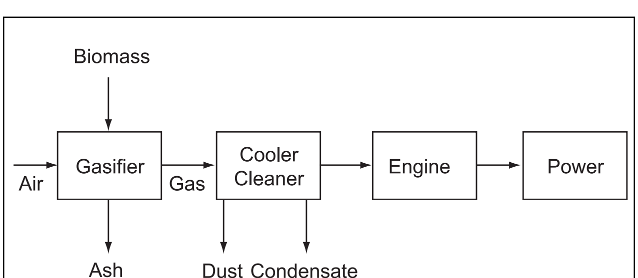


Figure 2

Source: World Bank Technical Paper no. 296, Energy Series

Sustainability

Sustainability of any rural electrification project has following three major dimensions:

Technical Sustainability

The power plant of “Husk Power Systems” is based on the well proven biomass gasification technology. A schematic diagram of power generation which is prevalent is shown in Figure 2.

A similar power generation model has been adopted by Husk Power Systems with three stages of filtering involved. The first filter with rice husk is responsible for absorbing the coal tar and the other two filters with fly ash absorb moisture. The gasifier used in the power plant is standard fixed bed, down draft type which is technically proven and is suitable[1] for rice husk based power generation under capacity range below 200 kW_{el}.

Financial Sustainability

In last 3 years of operations it has been observed that on average the user fee collected is about Rs 40,000 per month and the expenses comes out to be about Rs 20-25,000 per month and hence the project is financially sustainable.

Social & Institutional Sustainability

Husk Power Systems has institutionalized the standard procedures and practices in all its operational power plants. These include standardized power plant commissioning, operation and maintenance schedules. Moreover, through the in-house training centre in Patna, they have created a pool of skilled manpower which is very much needed in operation of power plants in these remote places. Moreover, they have created strong relationship network with their vendors which gives them a competitive advantage. All these factors taken together lead to institutional sustainability of a higher order.

SWOT Analysis

Currently there are 22 existing plants in 3 clusters (10 in cluster I in Padrauna region, 3 in cluster II on Tampuri road and 9 in Cluster III in Betiah and Motihari). Installation of about 30 plants is under way and the upcoming ones include 10 plants in Padrauna region,

Strengths	Minimum investment model fixed assets, Demand driven approach, Use of proven technology, Good linkage with rice husk suppliers, Low operational costs, Standardized operation and maintenance, Differential pricing, First mover advantage
Weakness	Frequency of disruption in electricity supply, Exclusion of those who cannot pay the high charges, Frequent rise in electricity charges, Non compliance of the promises made to some rice husk suppliers
Opportunity	Potential markets in other unelectrified villages and positive image of the organization with donors and funding organizations
Threat	Dependence on single fuel, Potential price rise in rice husk with other competitive users like paper mills, Brick kilns coming into picture and in case power grid reaches the villages, the model will not remain viable

17 in Betiah and Motihari, 5 in Muzzafarpur, and 1 in Lakhisarai). The organization's expectation is to meet the target of operating 2016 plants by the year 2016. Right now, they are working hard for achieving the target of starting 3 new plants per month. There are instances of power thefts hence efforts are being made by the auditing team to minimize the losses. Promoters are also considering putting a system at place where prepaid low cost meters are installed which can take care of 2-3 homes on an average. The meters would be programmed in a way that they will start beeping when the credit value tends towards zero. Fuses will be placed with every power connection which will break if the power consumed is more than the prescribed limit. Thus the business model adopted by "Husk Power Systems" appears promising for large-scale replication. A SWOT (Strength-Weakness-Opportunity-Threat) analysis is also presented for providing a snapshot of the entire project.

Courtesy: *WII Editorial Team with support from Husk Power Systems*

[1] Source: World Bank Technical Paper no. 296, Energy Series

UNDP / MNRE Project for Enhancing Access to Clean Energy

The Ministry of New and Renewable Energy, Government of India, is implementing a UNDP assisted Project for enhancing 'Access to Clean Energy'. The aim of the project is to accelerate access to energy services, particularly for increasing livelihoods of the poor and marginalized in seven UNDAF states (Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh).

As part of this project, the Ministry seeks to provide impetus to scaling up of commercially viable RET based business models that have been successfully piloted in the past. The current project will aim at strengthening technical, institutional, financial, delivery and servicing capability/ infrastructure needed to address the key barriers for up-scaling of technically proven and financially viable renewable energy applications. The proposed approach aims to stimulate widespread replications of these models and leverage additional resources for renewable energy development. Such wide-scale replication will create a "critical mass of demand" for renewable energy systems, which can further increase production and reduce their costs nationally and lead to a broader market acceptance of RETs.

NGOs, registered societies, entrepreneurs, technology suppliers, equipment manufacturers, corporate houses, self help groups, cooperatives, panchayats/ local bodies interested in being associated with the project can get themselves registered by filling in the relevant details in the form provided at the project website.

Details regarding the project may be viewed at project web site (http://www.winrockindia.org/HomePage.htm) or contact the Project Management Unit (PMU), Ministry of New and Renewable Energy, Block No. 14, CGO Complex, Lodi Road, New Delhi 110 003, Telefax: 011-24369788.

Biomass Gasification Based Distributed Power Generation for Rural India
– Identifying Barriers for Large-Scale Implementation

Introduction

Biomass gasification has been increasingly recognized as a very attractive technology for decentralized distributed generation (DDG), particularly at output levels of up to a few megawatts. In line with the very nature of biomass resource, it is very logical to plan strategies for resource utilization at a distributed and decentralized level. A number of countries have recognized the strength of such distributed development with policy initiatives that specifically encourage small-scale power generation. The technology has become very reliable and user-friendly with high plant load factor (PLF). Fortunately, India is clearly seen as the technology leader world wide and a number of megawatt level projects are currently coming up (some of them are in advanced stages of planning) in over fifteen countries, all based on technology and equipment from India. Many countries are offering very attractive policies and tariffs for such generation, an example being the recent policy in Sri Lanka with feed-in tariffs of over INR 8.5 per kWh from such power plants. This article briefly describes select projects in various countries which are based on the technology developed in India.

While there is extensive interest within the country as well, the pace of implementation is much slower. A large number of individual entrepreneurs and business industry enterprises have started to seriously examine such projects. However, significant barriers exist that prevent large-scale implementation in the near future.

The article focuses specifically on large-scale implementation of such biomass gasification based DDG systems, goes on to briefly outline the logic for such importance, identifies the immense benefits that could accrue from the proposed strategy and then goes on to specifically identify the barriers in large-scale implementation. The paper closes with a brief listing of policy measures needed to remove these barriers and to ensure proliferation of thousands of such power plants through private investments.

Technology Leadership Worldwide – On-going Projects

A number of manufacturers and institutions in India have been working on the technology for a long time now and this has led to a clear worldwide leadership position for the country in this technology area. There have been installations in over 25 countries like Australia, New Zealand, Bangladesh, Indonesia, Cambodia, Poland, Singapore, Colombia, South Korea, Sri Lanka, Germany, Taiwan, Italy, Tanzania, Madagascar, Thailand, Malaysia, Uganda, Nepal, USA, Ukraine and Latvia. The range of systems offered from India cover small ratings of less than 10 kW up to single gasifier based power plants of up to 2 MW. Larger installations are also being developed with multiple gasifiers but even for the smaller ratings, there have been significant exports for a variety of applications. A number of universities in Cambodia, Italy, and USA have imported 10 kW systems from India for R&D as well as for demonstration. Installations of small rating systems for a variety of applications have been made or are under implementation in countries like Sri Lanka, Cambodia, Malaysia, Colombia, Argentina, Uruguay, Cuba, Uganda, Madagascar, Benin, Australia and New Zealand.

4 kWe Power Plant in Colombia

Biomass Gasifier Based Power Generation Package GAS-250 in Cogeneration Mode for Uganda – A Specific Case Study

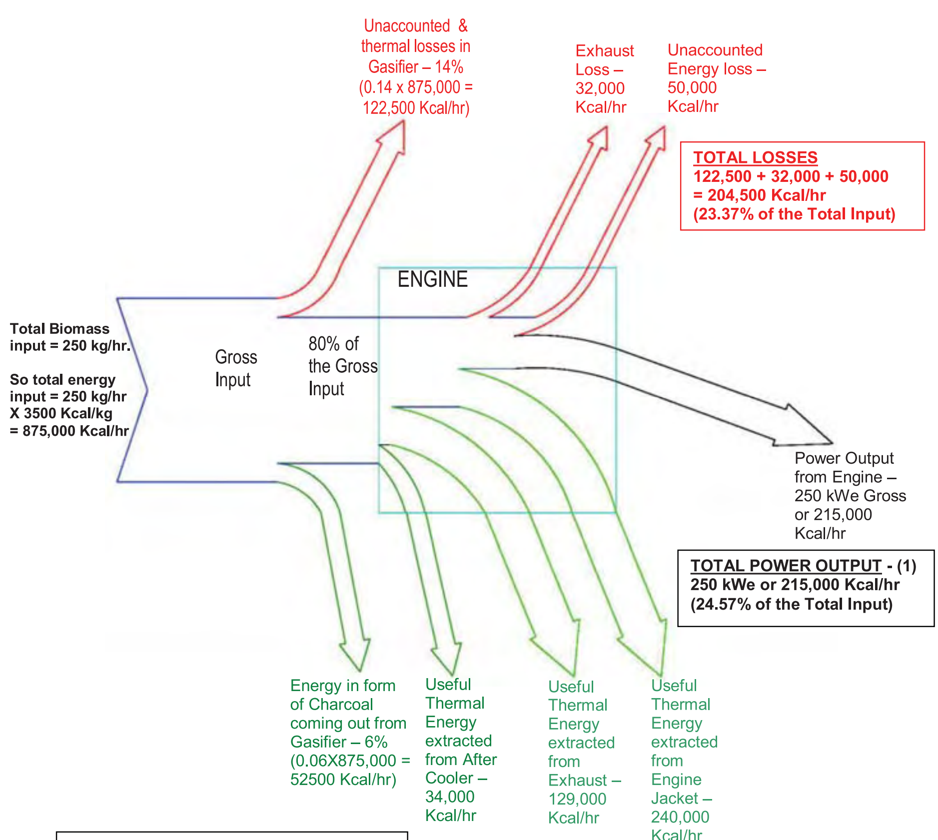
Efficiency Data / Salient Features at a Glance

Gross power output	:	250 kWe
Measured biomass consumption	:	250 kg/hr (with 15% moisture content)
Hence, specific fuel consumption	:	1 kg/kWe
Heat recovery in terms of hot air generated	:	35,000 kg/hr at 70° C
Heat recovery from engine jacket	:	≈ 100%
Heat recovery from engine after cooler	:	≈ 100%
Heat recovery from engine exhaust	:	> 80% (exhaust cooled from 425° C to 105° C)
Overall energy utilization in engine	:	> 88% (from gas to power/heat)
Overall engine utilization in cogen mode	:	≈ 70%

Likely oil saving for tea drying through hot air at 70° C ≈ 60 litre/hr

Thus power output of 250 kWe (Gross) or 200 kWe (Net) and 60 litre/hr of oil equivalent Heat through only 250 kg/hr of wood

OVERALL THERMAL BALANCE FOR THE GAS-250



TOTAL THERMAL ENERGY RECOVERED - (2)
34,000 + 129,000 + 240,000
= 403,000
(46.06% of the Total Input)

TOTAL ENERGY IN CHARCOAL- (3)
52,500 Kcal/hr
(6% of the Total Input)

Hence, total useful energy/output
= (1) + (2) + (3)
= 670,500 Kcal/hr

or 76.63 of Input

Grid connected GAS-500 for Latvia, under testing

A number of manufacturers and institutions in India have been working on the technology for a long time now and this has led to a clear worldwide leadership position for the country in this technology area. The range of systems offered from India cover small ratings of less than 10 kW up to single gasifier based power plants of up to 2 MW.

The focus of this paper is on somewhat larger plants of a few 100 kW to a few megawatts. The installations that have been made in the recent past or are under implementation are grid connected power projects in Italy and Germany (70 kWe to 500 kWe) and nine stand-alone power projects in Ukraine (320 kWe), among many others.

Large Scale Deployment in India – A Potential way Forward

While the international scene is becoming increasingly bright and attractive with ever larger number of projects being planned in increasingly larger number of countries and major initiatives in terms of technology licensing and creation of joint ventures with Indian technology providers, the situation in India is far less exciting. There has been a tremendous surge in interest in such megawatt level power projects with a large number of entrepreneurs and investors wanting to commit themselves to the sector, but lack of clarity on policy front have been discouraging such interested individuals and organizations. One very attractive strategy to accelerate the pace of development is to focus on large-scale implementation of biomass gasification based distributed power generation systems of 500 kWe to 2 MWe, preferably connected to tail-ends of the rural, 11 kV grids. In principle, over 10,000 such plants could be set up in the next few years. However, effective biomass management is required on a sustainable basis because of the limited biomass requirement which is in line with the major strength of the biomass resource, i.e. its dispersed nature. This would also result in creation of economic opportunities for wastes and residues throughout rural India, thereby generating large-scale employment opportunities. This will also help in significantly reducing the distribution losses through power input at tail-ends of rural grids. Also, there is ready availability of technology, hardware packages and complete EPC and O&M services to assist investors and entrepreneurs.

The major strengths of the system includes very high plant load factors of 80-90% (compared to 15-25% for solar and wind). There is a round-the-clock / on-demand generation of electricity and hence ability to meet peak demand. It can be easily managed by local, trained people as it is simple and robust technology based on internal combustion engines facilitating O&M, and it has a very short gestation period of a few months. Almost 80% of the cost of generation is returned to the local economy through purchase of biomass and local jobs [This is in total contrast to solar and wind where almost no revenues get returned to the local economy]. Rural 11 kVA grids become net producers of electricity thus ensuring uninterrupted power supply to rural areas. This technology results in more equitable distribution of economic development (revenues from sale of residues and employment generation) and it is more likely to create a large number of small entrepreneurs in rural areas. It also helps in the mitigation of global warming and providing perennial and sustainable green power. There is a much greater probability of success and long-term self sustainancy on the energy front. There is also potential for cogeneration through inclusion of cold chains in the power projects. Greening of barren and wastelands through production of sturdy energy species as small plants are conducive to energy plantations, leading to afforestation.

Major Barriers for Large Scale Proliferation

While there have been major policy initiatives in the country for both wind and solar power, this has not been the case for power generation from biomass. Even where policies for biomass based power generation exist, the focus is on combustion based projects of 10-25 MW rating. Biomass gasification based projects will have an order of magnitude smaller scale (and an order of magnitude larger benefits and probability of success) and need to be treated separately and simply. In some of the states where policies have been put in place, there is a tendency for zoning without clarity about such zoning being relevant only for large, combustion based power projects with the small gasification based projects being exempt from such zoning. Given the output ratings and the fact that a large number of small, individual investors would enter the field, there is a need for very clear and simple policies for grid feed, wheeling, banking, third party sales as well as applicable tariffs. Lack of such clear policy frame work therefore discourages small investors and entrepreneurs to enter in this sector.

Requisite Policy Facilitation

The program can be very quickly implemented if appropriate policy facilitations are put in place. The requisite policies are largely in line with the prevailing / proposed policies for other renewables like solar PV, solar thermal and wind and include issues like exemption from zoning with freedom to locate projects as per the assessments of the individual investors / entrepreneurs. Also, grid inter-connection for such small outputs should be permitted with the nearest 11 KV line (not having to be connected at the nearest sub-station). Steps like wheeling with minimum charges (2-4%), banking facility of electricity generated for up to one year, permission for third party sales without any cross subsidy charge, an incentive of Rs 2 per unit generated for sales to utility grids (over and above the tariffs determined by the Regulatory Commissions) on the lines of recently announced incentives of Rs 10 and Rs 12 for solar PV and solar thermal and automatic / single window and time bound clearance would contribute significanlty to the cause.

There is general consensus amongst a large number of experts and policy makers that this would indeed be an appropriate developmental strategy and what is urgently needed is necessary action on policy facilitation. This would open flood gates of interested individuals and entrepreneurs who could commit themselves to the sustainable energy and development strategy, leading to greening as well as economic well being of rural India with all associated benefits for the society and the nation at large.

Courtesy: BC Jain, *Managing Director*
Ankur Scientific Technologies Ltd., Vadodara, Gujarat
Email: bcjain@ankurscientific.com

Request for Articles

Bioenergy India is intended 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 Rs 1,500 each. Please send in your inputs along with your photograph to:

Ashirbad S Raha (ashirbad@winrockindia.org)
Winrock International India: 788, Udyog Vihar, Phase V, Gurgaon-122 001; Phone: 0124-4303868

IREDA's Initiatives in Development of Biomass Power & Cogeneration in India

India is a tropical country blessed with sunshine and rains and thus offers an ideal environment for biomass production, with a total potential of 16,800 MW biomass power and another 5,000 MW from bagasse based cogeneration. Out of this, more than 2,100 MW grid based capacity and 320 MW under captive mode have been installed. Indian Renewable Energy Development Agency Limited (IREDA), being a dedicated financial institution in this area, has financed over 91 biomass and cogeneration projects, with aggregate capacity of 890 MW.

Major techno-economic parameters taken into consideration while appraising any biomass projects include plant capacity, boiler configuration, fuel type, availability and cost, PPA duration and rate and the levelized cost of generation. These projects are environmentally benign, support energy security and provide firm power. Further, they can also provide both electrical and thermal energy requirements to many agro-based industries. In a country like India, which has a vast area under agriculture and produces huge amount of agro-residues, promoting biomass and cogeneration based energy generation projects is certainly a viable idea to meet its energy needs.

The biomass power/cogeneration program is being implemented with the main objective of promoting technologies for optimum use of the country's biomass resources for both grid and off-grid power generation. The technologies being promoted include combustion, cogeneration and gasification either for power in captive or grid connected modes or for heat applications. Some of the commonly used biomass materials as per the region-wise availability are given in Table 1.

The current availability of biomass in the country is estimated to be about 500 million metric tonnes per year, out of which 120 to 150 million metric tonnes can be used for power generation. These materials have an average calorific value of 3,500 kcal/ kg. This would correspond to an annual power generation of 10,000-12,000 MW taking the specific consumption as 1.5 kg per kWh. This apart, about 5,000 MW additional power could be generated through bagasse based cogeneration in the country's 550 sugar mills. The leading states for biomass power projects are Andhra Pradesh, Karnataka, Chhattisgarh, Maharashtra and Tamil Nadu.

To promote the development of biomass power and cogeneration in India, the Government is offering a number of fiscal and financial incentives. Some of them are:

- Central Financial Assistance
- 80% Accelerated Depreciation
- Concessional Import Duty & Excise Duty Exemption
- Income Tax holiday
- Preferential Tariffs (Rs 3.00 - 4.50 per unit)

As a result of the efforts put in by the Government and private entrepreneurs, a large number of biomass and cogeneration based projects have been commissioned in the country. More than 2,100 MW grid-based capacity and 320 MW capacity under captive mode has been installed. The target for the 11th Plan is 2,100 MW, for which the details are given in Table 2 (next page).

However, the developers of the biomass projects are facing several issues like:

- Inconsistency in Government policies (PPA, tariff, incentives)

Table 1: Different types of biomass in India

States	Biomass type
Punjab, Haryana	Saw dust, rice husk, rice straw
Rajasthan	Mustard stalk, sugarcane waste
Gujarat, Maharashtra	Cotton shell, castrol waste, groundnut shell, maize waste
Tamil Nadu, Karnataka, Andhra Pradesh	Rice husk, saw dust, groundnut shell, tamarind shell, coir pith, coffee husk

Table 2: Potential and installed capacity under the 11th Plan

Sector	Potential (MW)	Installation (MW)
Grid Connected		
Biomass	16,881	834.50
Bagasse cogen	5,000	1302
Captive/ CHP		
Non-bagasse	-	210.6
Gasifier	-	109.6

(Data as on 31.12.2009)

- Fluctuations in biomass availability and prices
- Change in profile of fuel
- Compatibility of fuel with boiler

Keeping in view the tremendous scope and inherent advantages associated with the biomass sector, IREDA has been supporting both cogeneration and biomass power projects by offering term loans, right since its inception. IREDA finances projects upto 10 MW capacity having a minimum steam pressure of 63 kg per cm^2 & temperature of 485 ^{0}C respectively. For details on IREDA's financing norms, please also refer *www.ireda.in.*

The techno-economic viability of the project is established based on various parameters, which are mentioned in Table 3.

Till the end of the financial year, 2008-09, IREDA has funded 91 projects with an aggregate capacity of 890 MW, out of which 677 MW has been commissioned.

Table 3: Technical and financial parameters

Technical	Financial
Capacity of plant based on site	Cost/ kW & cost/ kWh
Biomass type, transportation, storage	Fuel cost
Fuel availability	PPA – duration & rate
Power cycle & efficiency	Government incentives
Ash handling system	DER Ratio
O&M arrangements	Clearances / approvals

Table 4: Projects supported by IREDA

Sector	Capacity (MW)
Grid Connected	
Biomass power	214
Bagasse cogeneration	447
Captive/ CHP	
Non-bagasse	28.5
Gasifier	3.9

This is associated with total loan commitments of Rs 1,533 crore, the details of which are given in Table 4.

Looking at the success of IREDA, many financial institutions including commercial banks are coming forward to support biomass power and cogeneration based projects in India. The thrust of these organizations have in fact catalyzed the market development, leading to commercialization of renewable energy.

Courtesy: Sapan Thapar, *Assistant Manager Indian Renewable Energy Development Agency (IREDA) Limited, Delhi; Email: sapan@ireda.in*

Enterprise Development for Promotion of Biomass Gasifier and other Renewable Energy Devices

The initiative taken by the Ministry to promote biomass gasifiers using rice husk for generation of electricity to replace diesel in rice mills and for providing electricity in remote villages in the State of Bihar has emerged as a viable model for scaling up and replication in other rice producing states such as Uttar Pradesh, Orissa, and West Bengal. Huge possibility exist for setting up such systems not only to provide electricity for lighting in the villages but also for other productive purposes such as energizing irrigation pumps, powering mobile towers, cold storages, etc. In order to realize this huge potential, development of entrepreneurs for manufacturing, providing operation and maintenance services and setting up load centers, etc. is urgently required. Considering the effective and catalytic role which could be played by financial institutions, SIDBI and Ministry of Small and Medium Enterprises (MSME) for the development of Enterprisers, a meeting was organized in the Ministry in April, 2010 under the Chairmanship of Secretary. The meeting was aimed at encouraging and promoting biomass gasifiers in potential rice mills. In the meeting possibilities were identified to make use of various schemes of MSME, SIDBI and KVIC for development of entrepreneurs not only for biomass gasifiers but also for other renewable energy devices. A working group has been constituted in order to dovetail schemes of MSME for development of renewable energy enterprises.

Mr Deepak Gupta, Secretary, MNRE talking to stake-holders at one of the rice mill in Burdwan, West Bengal

The State of West Bengal has over 1,000 rice mills of which 500 rice mills are in Burdwan region. Most of the small scale industries including large number of cold storages are presently using diesel for meeting their power needs which can be effectively replaced by rice husk based gasifiers. A few installations have already demonstrated that diesel saving could be upto 70% and the rice husk ash can be profitably used for making pellets for boilers. Currently the state nodal agency is identifying rice mills for setting up gasifiers.

contd from pg 18

Conclusion

About 4,500 tonnes of baled trash was collected and transported to the factory bagasse yard between December 2008 and end of March 2009, when the crushing season 2008-09 came to an end. Out of this, 3,627 tonnes was used as support fuel for the boilers between 4th January to 31st March 2009, i.e. over a period of 86 days during the season. About 787 tonnes of trash was used as support fuel in off-season operation of the cogen plant over a period of 34 days. The commercial trial has been successful in generating additional revenue for the factory through sale of extra energy to the grid after meeting the cost of collection and transportation.

It has been established that the use of cane trash is much more economical than the bagasse procured from neighbouring mills. However, some improvements in the design of trash shredder and the boiler are required which shall be implemented, in consultation with the experts in the field, for the next season.

Acknowledgement

Our thanks are due to the Ministry of New and Renewable Energy, Government of India and UNDP/GEF for their technical and financial support.

Courtesy: KN Nibe, *Managing Director*
Shree Pandurang SSKL, Solapur, Maharashtra
Email: spssk_sugar@sancharnet.in

Japanese Biomass Policy - A view from Indian Policy Perspective

Biomass as a renewable energy option is gaining prominence worldwide and is much in sync with other renewable energy sources. Bio-energy markets are primarily policy driven, therefore decision makers need to have a comparative perspective on aspects such as drivers of policy design, policy targets, policy instruments in vogue and results and challenges across different countries. This article, as a part of series of comparative biomass policy analysis, presents a snapshot of Japanese Biomass policy, viewed from the Indian policy perspective.

Policy Drivers

Japanese government, considering Bio-energy's important role in meeting the energy requirement, envisaged an ambitious Biomass policy titled "Biomass Nippon Strategy", in the year 2002. This policy encapsulates all four major associated dimensions of biomass policy, viz.

- Strategy for promoting biomass utilization
- Strategies for the production, collection, and transportation of biomass
- Strategies for conversion of biomass
- Strategies for the use of biomass after its conversion

Design of strategies for aforesaid dimensions, primarily based itself on four drivers viz. prevention of global warming, formulation of recyclable society, nurturing industries strategically and vitalizing agricultural community. A comparison[1] of biomass use rates between the year 2002 and 2005 exhibits an increase in the use of domestic livestock manure from 80 percent to 90 percent. Primarily this is attributed to the enforcement of the Livestock Manure Law. On a similar note an increase in the use of food waste from 10 to 20 percent has happened due to the enforcement of the Food Waste Recycling Law. The overall utilization of waste biomass increased from 68 to 72 percent in carbon equivalent during the same period. The Japanese government, after reviewing this impact, came up with two important conceptual additions to the policy in the year 2006:

- Accelerate Biomass towns[2]
- Promotion of Bio-fuels

Other policies on specific aspects include, the "Research and Development Program for Prevention of Global Warming", the "Program for the Establishment of a Regional System for Practical Use of Eco-fuel" and the "Subsidy for establishment of ecofuel plants and related infrastructure in Japan", the "Kyoto Protocol Achievement Plan" and "Roadmap for Increased Production of Domestic Bio-fuels".

On the other hand, in India, historically, biomass has been a major source of household's energy. Biomass met the cooking energy needs of most rural households and half of the urban households (Shukla, 1996). Early policy perspective viewed biomass primarily as the solution to rural and remote area energy needs, in locations and applications where the conventional technology was unavailable. Since the early 1990s, there has been a noticeable policy shift. Under the market oriented economic reform policies pursued by the Government of India, the market forces are now allowed a greater role. The shift in the policy approach is characterized by: i) higher emphasis on market instruments compared to regulatory controls, ii) reorientation from technology push to market pull, and iii) enhanced role of private sector.

The above discussion reveals that renewable energy policy in general and bio-energy in particular, in both India and Japan had different under-cuttings which decided the design of policies. A quick comparison on objectives of Bio-energy development between both the countries is presented in Table 1.

With this basic backdrop of drivers of Bio-energy policy, the next section will enumerate the targets set by the policy documents.

Policy Targets

Bio-energy statistics, while highly imperfect, are essential to understand the dynamics of bio-energy systems. Storage and Use ratio of Biomass[3] in Japan is shown in Figure 1.

Table 1: Main Objectives[4] of Bio-energy Development

Country	Objectives						
	Climate Change	Environment	Energy Security	Rural Development	Agricultural Development	Technological Progress	Cost Effectiveness
Japan	X	X			X	X	
India			X	X		X	X

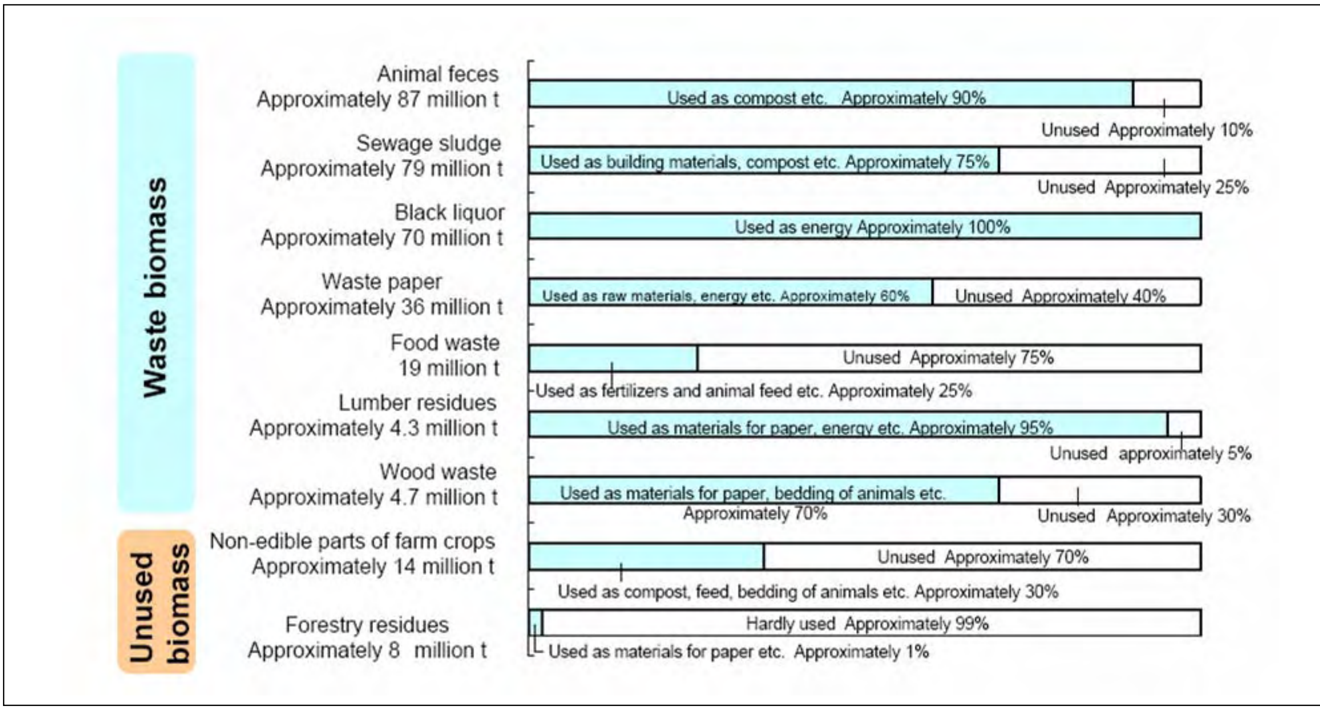


Figure 1: Storage and Use ratio of Biomass

Under "Kyoto Protocol target achievement plan", Japan intends to achieve power generation equivalent to 5,860,000 kL oil by 2010 from biomass and waste. A summary table of targets set in the policy, in both Japan and India, is presented in Table 2.

In the case of Japan, the approach for achieving these targets primarily rests on technological improvements for gaining efficiency. For power generation, the Biomass Nippon Strategy for conversion of biomass into electricity aims at achieving 20 percent efficiency for plants of capacity 10 tonnes per day and 30 percent efficiency for plants operating at 100 tonnes per day. Similarly, for conversion of biomass into heat, the strategy has set the target of reaching 80 percent efficiency in plants of capacity 10 tonnes per day. In the transport sector, as a medium-term plan for achieving domestic increase in production, lignocellulosic feedstock is in focus.

Policy Instruments

Different policy instruments like mandatory and voluntary targets, direct incentives, grants, feed in tariffs, compulsory grid feeding etc. are in use across different countries. Feed-in tariffs are currently the world's most widespread national renewable energy policy instrument[5]. Feed-in tariffs encourage investment in renewable energy production. India, as a policy instrument, is using feed in tariff to promote bio-energy for electricity generation. The main criticism of feed-in tariffs has been their shortcoming in ensuring minimum-cost electricity generation and to foster innovations. Japan, which is basing its bio-energy policy on technological improvements has possibly therefore avoided using "feed-in tariff" as a policy instrument. Japan has adopted compulsory grid connection as a policy instrument. Compulsory grid connection is often paired with feed-in tariff policies This as a policy tool, is not a

Table 2: Voluntary and Mandatory Bio-energy Targets[6] for Electricity, Heat and Transport Fuels

Country	Targets Voluntary (V, Mandatory (M)		
	Electricity	Heat	Transport Fuel
Japan	Biomass power generation & waste power generation in the amount of 5,860,000 kL, as converted to crude oil, by 2010 (V)	Biomass thermal utilization in the amount of 3,080,000 kl (this amount includes biomass derived fuel – 500,000 kL – for transportation), as converted to crude oil, by2010 (V)	500,000 kL, as converted to crude oil, by 2010 (V)
India	No targets	No targets	Development of biofuels has decided 20% of diesel consumption as blending target for 2011/2012

critically important policy, but serves as an incentive for overcoming the grid access barrier that is common for small and/or private energy producers.

Japan uses RPS[7] (renewable portfolio standard) as the main policy instrument to support renewables. India still has not enacted any national RPS targets or feed-in tariffs for renewables. The RPS or feed-in tariffs for renewables are offered at state level, which has restricted the renewable energy development to only some states. A comparison of policy instruments adopted by both countries for heat, electricity and transport is presented in Table 3.

Conclusions

The approach adopted by the Japanese government appears to address technological and policy challenges underpinning growth of bio-energy. Focus of research and development in all three major arenas i.e, electricity, heating and transport, will help Japanese industries to compete with countries like India which have a long tradition of bio-energy utilization. In the assessment of the year 2006, it was found that from the technological perspective[9], the production efficiency of biomass-derived plastics showed a year-on-year increase of 20 percent, exceeding the initial goal of 10 percent. The combined market[10] for biomass technologies and biomass-derived products is estimated to expand to 381.7 billion yen (about US $4.24 billion) in fiscal 2015, on the grounds of a yearly increase in demand for biomass technologies and a steady growth of sales of biomass-derived products. Focused efforts in research and development for improving efficiency of conversion is unequivocally, equally applicable in the Indian context.

In the past, a majority of the policy development designed was to support bio-energy at the national level. As production is increasing and cross-border trade is becoming more substantial, regional efforts are becoming increasingly common. Perhaps this is one core reason why Japan is encouraging regional focus through development of "Biomass Town".

Table 3: Key Policy Instruments[8]

Country	Energy Policy Binding Targets/Mandates[1]	Voluntary Targets[1]	Direct Incentives[2]	Grants	Feed in Tarrifs	Compulsory Grid Connection	Sustainability Criteria	Tariffs
Japan		E,H,T				E		Eth, B-D
India	T, (E*)		E	E,H,T	E			NA

E: electricity, H: heat, T: transport, Eth: ethanol, B-D: biodiesel ,* target applies to all renewable energy sources, policy instrument still under development/awaiting approval, [1] blending or market penetration, [2] publicly financed incentives: tax reductions, subsidies, loan support/guarantees

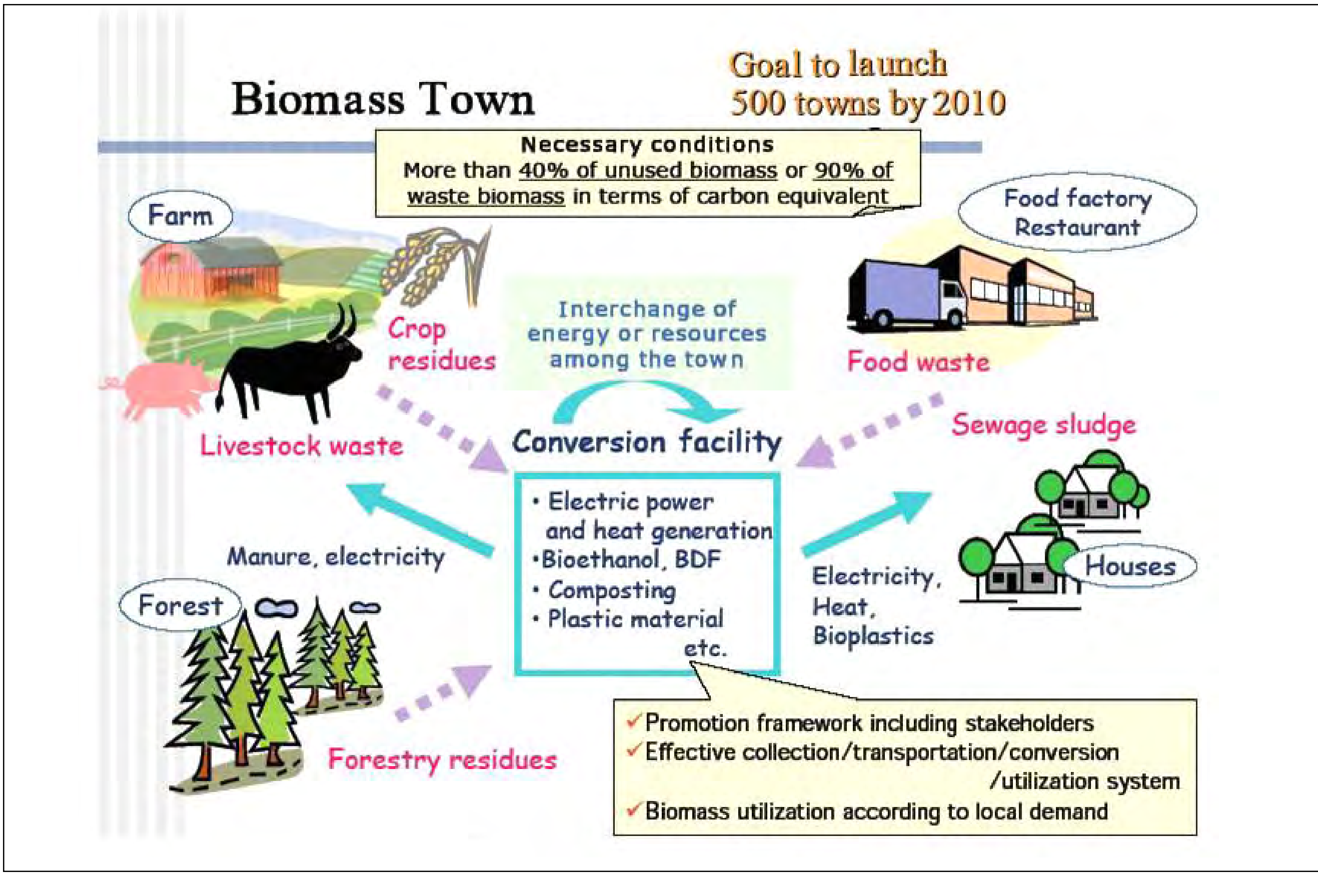


Figure 2: Biomass town

The Ministry of Agriculture, Forestry and Fisheries invited municipalities that actively and appropriately produce and use biomass fuels to apply for "Biomass Town" designation. Entries are examined for conformity to standards set by the Biomass Japan Comprehensive Strategy Promotion Council. Those municipalities which meet the standard norms, their information is shared among the six relevant Ministries that can help establish an environment for the Biomass Town to promote active participation by local citizens, a main catalyst for further development. India can also gain by putting more emphasis on regional cooperation to harmonized policies which are necessary for continued bio-energy market growth.

Endnotes

1. http://www.japanfs.org/en/pages/026682.html
2. A community which utilizes biomass comprehensively with strong ties between a community and local stakeholders. Government promotes Biomass Town for the achievement of one of the Biomass Nippon Strategy's goals: 300 biomass towns by 2010
3. Ministry of Agriculture, Forestry and Fisheries, Japan, November 2009
4. Global Bio-energy Partnership (GBEP) report, 2008
5. Rickerson, Wilson, and Robert C. Grace. "The Debate over Fixed Price Incentives for Renewable. Electricity in Europe and the United States: Fallout and Future Directions." A White Paper Prepared for The Heinrich Böll Foundation. February, 2007.
6. As stated in country summaries and key policy documents
7. http://www.renewableenergymagazine.com/paginas/Contenidosecciones.asp?ID=14&Cod=4735& Tipo=&Nombre=Latest%20news
8. Global Bio-energy Partnership (GBEP) report, 2008
9. http://www.japanfs.org/en/pages/026352.html
10. "Biomass Utilization Market 2008: Total Picture and Future Outlook," Fuji Keizai Co.

Courtesy: Sharda Gautam, *Program Associate*
Winrock International India, Gurgaon, Haryana
Email: sharda@winrockindia.org

7th International Biofuels Conference

Biofuels is a widely discussed topic internationally as well as in India. To take steps towards production and consumption of biodiesel, Ministry of New and Renewable Energy (MNRE), Government of India recently announced the much awaited Indian Biofuels Policy.

Winrock International India, a New Delhi based NGO with a national presence, working in the areas of clean and renewable energy, natural resources management and climate change, organized the 7th International Biofuels Conference in partnership with Indian Oil Corporation Limited (IOC) and International Union for Conservation of Nature (IUCN) on February 11 & 12, 2010 at Hotel Le Meridian, New Delhi. The conference was also supported by the Ministry of New & Renewable Energy, Department of Science & Technology, National Bank for Agriculture and Rural Development, RE-Impact project supported by Europe Aid Cooperation Office, Evonik Industries and Axens India Ltd.

The conference brought together several dignitaries in the area of energy conservation and biofuels. Dr Ashok Khosla, President, IUCN, inaugurated the conference and said that in the quest of short-term optimization of energy demands, we should not focus on one alternative as it would mean sub-optimizing bigger systems.

Mr Anand Kumar, Director, R&D, IOC laid importance on IOC's plan to plant Jatropha plants on 300,000 hectares of wasteland and their focus on using biofuels as a transport fuel. Dr H L Sharma, Director, Biofuels, MNRE, who played an important role in the formulation of the National Biofuels Policy, mentioned that India is serious about the promotion of biofuels and if states, industries and NGOs work together, we can make the use of biofuels in various states a reality.

One of the key sessions of the event was that on International Policy Experiences, where delegates from India, China, France, UK and Switzerland shared their experiences with the various methods of biofuels production. Their presentations focused on several sectors of biofuels in use, such as transportation and power generation. Of particular interest were the deliberations on algal biodiesel and its underlying economics.

The session on Food security & Sustainability issues saw participation from Dr Neil Bird, an international expert on biofuels from Joanneum Research, Austria, who mentioned that India may meet its biofuels targets but requires expansion of agricultural land or improvement in productivity. The final session, the panel discussion chaired by Dr DN Tewari, Vice Chairman, State Planning Board, Government of Chhattisgarh, raised issues on converting Biofuels policy into an action plan. Dr MS Haque, General Manager, NABARD informed the audience about the sanction of 300,000 Jatropha plantations in Andhra Pradesh among various other initiatives and mentioned their success.

Several issues related to availability of land and thereafter availability of feedstock and its yields for conversion into biodiesel were raised. There were discussions about seriously looking at second generation biofuels to meet the targets as defined in the policy. It was recommended that a roadmap with action points be developed in order to implement the policy effectively and in a time-bound manner. There were also concerns that the transport sector had not been included as a stakeholder, though it would be one of the largest beneficiaries of the biofuels program in the country.

Concerns were also raised that decentralizing the production of biofuels needs to be done in order to address rural energy needs with biofuels and then sell the surplus oil to the neighboring areas. This would help in overall development of our rural areas thereby adding to the economy of the country. Much in sync with the Green and White revolutions now is the time for "Energy revolution", but that must begin with making villages energy sufficient.

On the whole, the conference focused more on the ecological and socio-economic impacts of traditional methods of feedstock generation. Interactive sessions were held on emerging technologies and their roadmaps to commercialization. The presence of high level delegates, both from India and abroad, strengthened the quality of deliberations and added immeasurably to the event's overall impact.

Courtesy: *WII Editorial Team*

Cummins Power Generation Supports Initiatives on Biomass Energy

As the world recognizes the concerns of fast depleting natural resources in the future, the exhausting reserves of fossil fuels and the adverse impact of global warming on climate change, researchers are facing the challenge to accelerate innovation in this area. For the same concern, there has been a visible shift in the fuel use pattern in various industries that have gradually shifted to the other available options.

Potential – Biomass Energy

The technology of biomass gasification has existed for more than seventy years. Subsequent to World War II, this technology did not gain popularity on two counts. The first reason being unrestricted world over availability of petroleum fuels at a low cost. The other reason was technological problems relating to the presence of high level of tar content in the producer gas, which posed a threat to engine operations. Because of the ongoing oil crisis, there has been a sporadic interest in biomass gasifiers. However, sustained global interest was developed only in the recent times becuase of issues like Green House Gas (GHG) emission reduction and carbon-trading through clean development mechanisms. Also, a steep rise in the oil prices has had a severe impact on the industrial economy which has forced many oil-importing countries to reconsider gasification technology and initiate improvements in them. Additionally, fossil fuels are depleting rapidly and are not available everywhere leading to extra transport time plus cost. In India, the scale of producer gas based power generation potential is huge as given below:

Processing based agro residues (Rice husk, Maize cobs, Coconut shells, bagasse, etc)	1,868 MW
Field based agro residues (Rice straw, Wheat straw, all agro waste in field, etc.)	1,3843 MW
Willow dust	245 MW
Food and fruit wastes	50 MW
Other	1,500 MW
Total	**17,506 MW**

Estimation -Source: MNRE and TERI

Government of India - Ministry of New & Renewable Energy has also offered fiscal and financial incentives to promote these projects.

The Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) provides capital subsidy for instalation of small scale renewable energy projects.

Considered in totality, power produced using biomass energy provides distinct benefits like:

Seen in the picture are some commonly available biomass in India

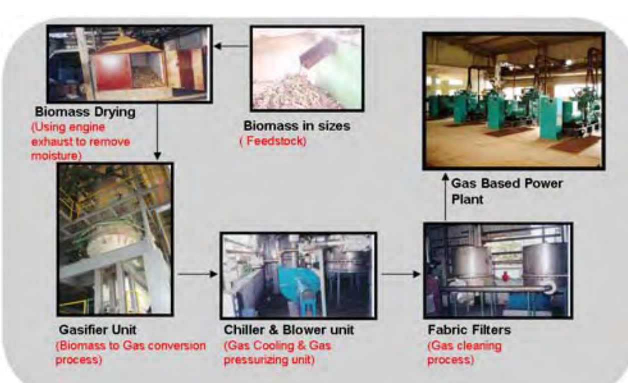
- Affordability
- CDM benefits through carbon trading
- Sustainability
- Supports rural development programs through employment while supplying power locally. Biomass gasification based decentralized standalone power plants is one of the solution for mitigating the rural power problem.
- Encourages tree plantation to bring down ambient temperatures which leads to improved rain fall

Producer Gas based Power Generation

The production of energy from dry biomass gas involves two simple, yet different processes termed as gasification and combustion. In combustion, fuel gets 'ignited' in the presence of oxygen, which "burns" to release energy in the form of 'heat'. The same heat energy is utilized to generate steam from fluids as a source of power. Typically, combustion efficiency of 15% to maximum 20% is achieved and one can generate 1 kWh power from 2 kg/hr to 2.5 kg/hr biomass 'burnt' in combustion.

On the other hand, in case of gasification, fuel is 'ignited' in the absence of oxygen or in an oxygen deficient environment and hence is not allowed to 'burn'. Therefore, the energy supplied in the form of 'ignition' gets utilized to break molecular bonds of fuel composition, resulting in the decomposition of carbonaceous fuel into simpler form. As a result of this process, all volatile matter present in the fuel gets liberated in the form of gaseous compounds, whilst non-volatile matter, which remains as it is, gets converted automatically into a more stable form, known as 'coal'. The complex gas liberated is generally a Volume by Volume (V/ V) mixture of:

- Carbon-monoxide (CO) - 18% (+/-2%)
- Hydrogen (H_2) - 18% (+/-2%)



A schematic representation of power generation from biomass

- Methane (CH_4) - 2 %
- Carbon dioxide (CO_2) - 10%
- Oxygen (O_2) - 2%
- Nitrogen (N_2) - Rest all

Considering CO and H_2 are fuel gases, the calorific value of the above mixture is generally found to be 1,000 to 1,200 kcal/m^3. During this process, this gas also collects particulate matter, tar and oil particles so generated. Popularly known as 'producer gas', this gas can be utilized as gaseous fuel for thermal applications (heat) as well as for generating electric power through gas-based Internal Combustion (IC) engines.

Typically, the overall efficiency of a gasification power cycle is anywhere between 22 to 23%. In addition to this, the profitability of the project improves further due to coal recovery of up to 10% of the quantity of fuel consumed. Due to these advantages, gasification of biomass is being considered as a more productive method vis-à-vis combustion and hence is being promoted extensively worldwide.

Moreover, in gasification, capacities even as less as 5 kW can be installed with as much ease as capacities with large MW. While in combustion (through steam turbine), only MW capacities can be installed due to which most locations having lesser quantities of agro residues cannot be powered at all. Power generation projects based on the biomass gasification process consist of the following essential systems:

- Fuel/feedstock collection and sizing system
- Sized feedstock drying system
- Dried feedstock conveying system (automatic for large projects and manual for smaller projects)
- Biomass gassifier for producer gas generation
- Wet scrubbers, and gas cleaning and cooling systems for removal of ash, particulate matter, oil particles and coal
- Effluent treatment plants for recirculation of process water
- Carburetion system for gas generator set
- Gas engine generator set for power generation
- Power evacuation system

Courtesy: Indrajit C Shirole, *GM(Projects)*
Cummins Power Generation, Pune, Maharashtra
Email: indrajit.shirole@cummins.com

News Snippets on Biomass Power

Biomass Power Plants for Punjab

Aiming to make Punjab power-surplus in the next two years, a biomass power plant, one of over 30 planned in the state, was inaugurated at Muktsar, 70 km from Bhatinda.

Union Minister of New and Renewable Energy, Dr Farooq Abdullah, who inaugurated the plant, termed it a revolution as it transforms agricultural residue into much needed power and provides employment and additional income to neighbouring villagers. Built with an investment of Rs 80 crore, the plant will produce 14.5 MW of electricity and provide employment to over 700 people.

Punjab Deputy Chief Minister Sukhbir Singh Badal said that nearly 50 more biomass plants would soon transform the state into a power-surplus entity. "Our promise to make Punjab a power-surplus state will be a reality thanks to these plants, which will solve many problems at once. This plant would purchase agricultural waste worth over Rs 30 crore from the villages in its 40-km radius, giving additional income and employment."

Punjab produces over 20 billion tonnes of agricultural residue every year, which can produce over 1,000 MW power from agro-waste alone.

The plant uses agricultural wastes and produces none itself. Inputs like cotton and rice husk, cow-dung, straws and stalks of paddy, cotton and wheat produce electricity. Its by-product, fly-ash, is used to make bricks which are used in construction.

Source: *http://www.hindu.com/2010/02/20/stories/2010022054700500.htm*

MNRE Focus on Rice Husk-based Energy

Recognizing the potential of the sector and its relevance in the backdrop of the energy crisis the country is facing, the MNRE is focusing on the installation of rice husk-based energy generation projects in rice mills on a cluster basis, MNRE Secretary, Mr Deepak Gupta said recently while addressing a seminar on promotion of Biomass Gasifiers Cogeneration project in Rice Mill, organized jointly by Cogeneration Association of India, All Orissa Rice Mills Association, and IPICOL.

There are about 140,000 small, medium and big rice mills in the country operating to process about 93 million tonnes of rice annually in the form of raw rice and par-boiled rice. Out of this, about 7,000 rice mills are in operation in Orrisa. "These mills are generating a large quantity of rice husk which is a very remarkable source of renewable energy and can be utilized for the generation of steam and power by installing biomass gasifiers or biomass cogeneration projects. In addition, surplus rice husk may be utilized for installing rice husk-based power projects at nearby sites for supplying electricity to nearby villages/hamlets and rural industries," he said.

Source: *http://www.financialexpress.com/news/mnre-focus-on-rice-huskbased-energy/581618/*

B&W, Thermax to form Indian Joint Venture

Babcock & Wilcox Power Generation Group, Inc. (B&W PGG) and Indian energy-environment solutions provider Thermax Ltd. have formed a joint venture to build highly efficient subcritical and supercritical boilers and pulverizers for the Indian utility boiler market. B&W PGG is an operating unit of The Babcock & Wilcox Company (B&W).

The new company will have its headquarters at Pune in the Maharashtra. Under the terms of the agreement, B&W PGG will also license its technology to the joint venture company for subcritical boilers of 300 MW and larger, supercritical boilers and coal pulverizers. The joint venture will have the full capability to engineer, manufacture and manage large power projects for the Indian power sector. As part of the agreement, the partners will also construct a new pressure parts fabrication facility in India.

"B&W PGG and Thermax have successfully worked together on other joint ventures and licensing agreements for more than two decades," B&W PGG President and

Chief Operating Officer, Richard L. Killion said, "This agreement augments our presence and profile in the global marketplace and presents a substantial opportunity to continue the growth of our business in India and around the world."

The joint venture is being established at a critical time when India's ambitious growth plans, coupled with the country's dependence on coal-fired power plants, present a tremendous opportunity to participate in a robust power market. The initiative combines B&W PGG's long history of proven state-of-the-art power generation technology and world class project management capabilities with Thermax's expertise of integrating energy and environmental solutions in the Indian market. B&W PGG will own a 49 percent share of the joint venture while Thermax will have 51 percent ownership.

Source: *http://www.babcock.com/news_and_events/2010/20100310a.html*

Renewable energy firm to build Biomass Plant for giant soft drink maker

It is perhaps for the first time that a soft drink bottling plant will integrate a green cogeneration power facility to its complex. Solutions Using Renewable Energy Inc. (SURE) will install a state-of-the-art and environment-friendly power facility for Pepsi-Cola Products Philippines Inc. (Pepsi Philippines). This is in support of the soft drink maker's program to assure a supply of cheap electricity and fight global warming. SURE is a Philippine firm with the widest portfolio of local renewable energy projects. Its projects include the biggest integrated waste-to-energy project in Vietnam. An agreement was recently signed to construct a 1.2-megawatt, rice husk and wood chip-fired cogeneration power plant at a cost of $2.7-million inside the bottling company's complex in Rosario, La Union. The project is expected to be completed in January 2011.

Source: *www.worldofrenewables.com*

Sewage to biogas in London

A sewage work upgrade project planned by UK utility provider Thames Water will also introduce an anaerobic digestion process, where solid waste is broken down in enclosed tanks in the absence of oxygen. This process forms biogas which can be used to generate renewable energy, and it is intended to produce enough energy to power the entire site.

Thames Water began the £85 million upgrade at Riverside Sewage Works in east London to improve the quality of water in the river Thames. These upgrades form part of a larger £675 million project to modernize London's five main sewage works.

Source: *http://www.biofuels-news.com/industry_news.php?item_id=1881*

RWE Innogy builds world's largest pellet factory in Georgia, United States

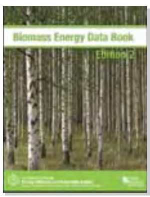
RWE Innogy is to build a factory to produce biomass pellets in the southern part of Georgia (USA). The plant will have an annual production capacity of 750,000 tonnes, thus making it the biggest and most modern of its type in the world. The project will be carried out in collaboration with BMC Management AB, which specialises in the development of biomass manufacturing solutions and is based in Sweden. The pellets will be used in pure biomass power plants as well as for the co-firing of coal and biomass. The pellets plant is due to take up operation in 2011. The total investment volume amounts to approx 120 million. The biomass pellets will initially be burnt in the existing power plants of Amer in the Netherlands. Here, up to 30% of the hard coal has already been replaced by solid biomass, mainly wood pellets. The considerable volumes of biomass from Georgia will also help in expanding this co-firing to up to 50%. The CO_2 reductions achieved will be of a corresponding level. The two power plant units belong to Essent, which RWE took on as a result of the partnership that both companies entered into, in September 2009.

These have a total installed capacity of 1,245 MW_{el} as well as 600 MW_{th}. The use of the biomass pellets is to be extended to other pure biomass power plants and also to conventional power plant sites in the Netherlands (e.g. Eemshaven power plant, which is currently under construction), Germany, Italy and the UK. Forests in Georgia provide enough wood to sustainably produce the pellets.

Source: *www.worldofrenewables.com*

Book & Reports

Title: The Biomass Energy Data Book
Publisher: Oak Ridge National Laboratory (USA)
Year of Publication: 2009
Number of Pages: 246



The *Biomass Energy Data Book* is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) in association with the Office of the Biomass Project under the Energy Efficiency and Renewable Energy (EERE) program of the Department of Energy (DOE), USA. The book represents an assembly and display of statistics and information that characterizes the biomass industry, from the production of biomass feedstock to their end use, including discussions on sustainability. There are five main sections within this book. The first section is an introduction which provides an overview of biomass resources and consumption followed by a section on biofuels, which covers ethanol, biodiesel and bio-oil. Their are other sections focussing on the use of biomass for electrical power generation and heating, developing area of bio-refineries, and feedstocks that are produced and used in the biomass industry. The sources used represent the latest available data. There are also four appendices, which include frequently needed conversion factors, a table of selected biomass feedstock characteristics, assumptions for selected tables and figures, and discussions on sustainability. A glossary of terms and a list of acronyms have also been included for the readers convenience. This is the second edition of the *Biomass Energy Data Book,* which can be downloaded from www: cta.ornl.gov/bedb

---

Title: Global Potential for Bioenergy, Sufficient to meet Global Energy Demand
Published by: Swedish University of Agricultural Sciences, Sweden
Year of Publication: 2009
Number of Pages: 32

A position paper by World Bioenergy Association (WBA) based on a report by the Department of Energy and Technology at the Swedish University of Agricultural Sciences (SLU) shows that the global potential to produce biomass for energy in a sustainable way is sufficient to meet global energy demand. Based on different scientific studies, the potential for bioenergy production has been estimated at 1135–1548 EJ (ExaJoule) by 2050. The global energy consumption currently is 490 EJ, and could reach well over 1000 EJ in 2050, according to IEA projections. The current use of biomass for energy is only 50 EJ, which accounts for just around 10% of global energy consumption. Bioenergy crops are grown on 25 million hectares, which is only 0.19% of the world's total land area and 0.5% of the total agricultural land. The position paper and the report can be downloaded from www.worldbioenergy.org

Title: Black Carbon Emissions in Asia: Sources, Impacts, and Abatement Opportunities
Published by: USAID ECO-Asia Clean Development and Climate Program (ECO-Asia)
Year of Publication: 2010
Number of Pages: 72

The report on Black Carbon Emissions in Asia: Sources, Impacts, and Abatement Opportunities released by USAID ECO-Asia Clean Development and Climate Program (ECO-Asia) talks at length about the properties of black carbon that act as a contributor to global warming, and the direct and indirect impacts of black carbon with respect to global warming, natural ecosystems, human health, etc. The report also throws light on the most immediate opportunities for reducing black carbon emissions in the Asian region. The report contains detailed findings and recommendations that should be of substantial interest to regional policymakers, donors, climate experts and development professionals. The full report can be downloaded from www.cleanenergyasia.net/upload/resources/file/file_702.pdf