In Focus

- Interview with Dr. Farooq Abdullah
Biomass is a primary source of energy for close to 2.5 billion people in developing countries. It is easily available to many of the world’s poor and provides vital and affordable energy for cooking, space heating and water heating. Majority of the biomass users, including both domestic users and hotels, have installed traditional, highly polluting cookstoves for various needs. These stoves are characterized by very low thermal efficiency which is below 10% in most cases. Inefficient and excessive usage of firewood results in emission of toxic gases like carbon monoxide and damages the indoor air quality adversely which affects the health of the workmen, especially the women and children. Thus substitution of traditional cook stove technology with the clean and improved technology for direct biomass combustion in developing countries is essential to address poverty and public health issues in rural and some urban areas. The availability of this richer menu of technology, delivery, and financing options and even greater purchasing power within some segments of biomass users has resulted in cookstoves programs that are diverse in terms of programmatic design.

Infact since the energy crisis of the 1970s, improvement in biomass burning cookstoves to save fuel was considered as an urgent need and various organizations the world over started working towards the same. Several developing countries started national level initiatives to enable the development and deployment of improved stoves. In India, the then Department of Non-conventional Energy Sources (DNES), which was created in 1982 initiated demonstration of improved cookstoves soon after its inception followed by launching of a Demonstration project on Improved Chulhas in 1983 which was converted to National Project on Improved Chulhas (NPIC) in 1985. The NPIC was then implemented through involvement of various State Nodal Agencies in almost all the States and Union Territories. A total of 35.2 million improved chulhas were installed by 2003 under this programme with varying degree of success in different regions in the country.

The current portal aims to showcase the latest development in the cookstove field, in terms of both technology and delivery model. To capsulate it further, the ultimate objective of the current initiative, through the portal, is to provide a common platform for all the participant nations of the world to prepare further course of action to fulfill ultimate common objective, i.e., providing the safe, pollution free and cost effective option to cater the thermal requirement of the cookstove users.

For more information on the Biomass Cookstove Portal, log on to http://www.winrockindia.org/mnre/home.htm
Dear Readers,

Our efforts continue to present the latest in bioenergy through this 6th issue. As we move ahead, we hope to keep bringing into focus the newest developments and the latest events.

The main focus of this issue are the valuable excerpts from interview with the Honorable Minister Dr Farooq Abdullah, Ministry of New and Renewable Energy, Government of India, as he shares his views, opinions, and comments about development of bioenergy in India. This issue also includes our field review where we take you ‘Towards Substantial Green Energy Supply in Karnataka’. This field visit explores the potential of biomass energy in fulfilling rural energy demands of the state. It provides a detailed analysis of how biomass in the state of Karnataka has the potential to generate electricity from biomass, using both woody biomass and agricultural residues. This field work is an interesting read as it argues with evidences that biomass energy is energy for all seasons and for all reasons. This issue also explores the potential of biomass energy in the state of Haryana. This article brings to our readers the agricultural biomass assessment of various crops in the state with detailed data.

Facing one of the biggest challenges of our times - climate change, we explore the possibility of an option to mitigate climate threats focusing on agro industries. Carbon foot printing approach adopted by organizations as well as individuals could pave way to a better future. This issue features an article that explores in detail the approaches, the methods of implementation bringing to our reader’s notice the significance of this process. Bringing international flavor to the contents of the magazine is the Ashden Award-winning biogas program from SNV Nepal.

Bringing the latest events happening in the sector has always been our attempt. The editorial team of Bioenergy India attended the bioenergy related events held during Delhi International Renewable Energy Conference (DIREC 2010). An event coverage write up in this issue brings to our readers the deliberations on bioenergy development that discussed a spectrum of issues with an aim of up-scaling and mainstreaming renewables for energy security, climate change and economic development. It was heartening to receive warm appreciation for the Bioenergy India magazine during the international conference, as more than 500 copies of the magazine were eagerly picked up at the venue itself.

As always, we would like to welcome your feedback regarding the magazine to help us bring to you the best and the latest in bioenergy in the most elaborate and well researched manner. Your valuable comments, suggestions, and questions help us improve and perform better.

We look forward to hearing from you and your contribution into making ‘Bioenergy India’ better and more improved.

Wishing you all a happy and prosperous New Year 2011.

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

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I really like the magazine Bioenergy India. The articles published are quite useful and give very useful insights on the subject.
Poornam Gangwal, MBA-FT
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In Focus

Hybrid Vermicompost Biodigesters – Empowering the Rural Households

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Can all Biomass be Treated Equal?

News Snippets
Excerpts from the Interview with Hon'ble Minister Dr. Farooq Abdullah

Renewable energy is considered as one of the most promising alternatives for times to come. Recognizing this potential, India has been implementing one of the largest renewable energy programmes in the world. Among the several renewable energy technologies, bioenergy has a large diverse portfolio including efficient biomass stoves, biogas, biomass combustion and gasification and process heat and liquid fuels. To enlighten the readers of Bioenergy India more about India’s dream, plans and hopes from Bioenergy, Honorable Minister of New and Renewable Energy (MNRE) recently shared his views with the magazine in an interview.

Q. 1. Sir, You have been the Cabinet Minister in the Ministry of New and Renewable Energy (MNRE) for nearly two years now. How do you look to the overall prospects of meeting India’s energy needs through a mix of Renewable Energy (RE) technologies in the next 5-10 years.

Ans. The Renewable energy sources based power potential is estimated at about 85,000 MW. A cumulative grid interactive power generation installed capacity of over 18,000 MW from various renewable energy sources mainly wind, small hydro, biomass and solar energy has been set up so far. This corresponds to 10% of the total power generation installed capacity from all sources in the country with 3% contribution to the electricity mix. Even though the contribution of renewable energy systems to energy mix is low, the decentralized and distributed nature of this energy offers many socio-economic benefits.

During the 11th Plan period, a capacity addition of 12,500 MW grid interactive renewable power is targeted. Further capacity addition of about 57,500 MW is envisaged during 12th and 13th Plan leading to a total capacity of about 80,000 MW. This comprises of 43,500 MW wind power, 8,900 MW from small hydro, 7,400 MW from biomass and 22,000 MW from solar power, as envisaged by 2020 under the National Solar Mission. This would correspond to about 9% in the electricity mix from all sources and would be a significant contribution to the energy security point of view of our country.

Q. 2. Your Ministry has been actively promoting the use of Biomass and Bagasse based power generation for more than a decade now. What new dimensions are you contemplating to enhance its outreach still further?

Ans. The Ministry has been actively promoting Grid Interactive Power Generation Projects based on Renewable Energy Sources including projects based on biomass. In the last 10 years, a cumulative capacity of 2,200 MW has been commissioned, which comprises of 1,335 MW Bagasse Cogeneration Projects and 865 MW of Biomass Combustion Projects. The States which have taken a leadership position in implementation of biomass power projects are Andhra Pradesh, Karnataka, Tamil Nadu, Chhatisgarh, Maharashtra, Punjab and Rajasthan. The capacity of grid connected Biomass Power Projects varies from 8-15 MW. During the 11th Five Year Plan (2007-2012), it is planned to establish 1,700 MW and during the first three years of the 11th Plan, about 1,100 MW has already been set up.

The Ministry has been taking many initiatives in the biomass sector during the last 2-3 years in order to promote sustainable biomass based power systems. The biomass gasifier based programme has been recently modified to facilitate faster implementation with the active involvement of promoters, manufacturers and financial institutions. A new component for promoting small grid connected biomass power projects (up to 2 MW), which would have less difficulties for establishing sustainable fuel linkages has been included in the scheme...
with preferentially higher central financial assistance. The Ministry has also modified bagasse cogeneration programme in order to support the initiatives taken in the states of Maharashtra, Punjab and Tamil Nadu to set up bagasse cogeneration projects in the cooperative sector sugar mills through BOOT Model.

Q.3. The Indian RE scenario is expected to brighten up with the taking off of the much awaited National Solar Mission. Is there a clear possibility of setting up an exclusive mission for the Biomass energy sector along the same lines?

**Ans.** National Solar Mission is one of the eight missions envisaged under the ‘National Action Plan on Climate Change’ released by the Hon’ble Prime Minister in June, 2008. The National Action Plan inter-alia includes directions to promote deployment of other renewable energy systems such as Biomass (both combustion and gasification based systems), hydro power, wind energy, etc. in order to mainstream renewable energy sources in the national power system. The Ministry has initiated preparation of Action Plan in different sectors of biomass such as rice-husk based electricity generation for industries and rural areas, utilization of rice straw for generation of power, smaller biomass power projects at the tail-end of the grid, cane trash utilization for additional power, utilization of biomass as energy source for cold storages and thermal application in industries, etc. Large-scale projects in these areas would lead to efficient utilization of biomass in various sectors.

Q.4. The current energy use in India is accompanied by serious environmental implications such as GHG emissions, deforestation land degradation, water and air pollution. Is an enhanced use of biomass a quick fix solution to reverse at least some of the damage to our environment, more so under the Clean Development Mechanism (CDM)?

**Ans.** There is no quick fix solution to reverse the damage which we have done to the environment. Nevertheless, all countries have to make possible efforts to reduce the fossil fuel consumption and encourage use of environment-friendly renewable energy sources. In this context, all renewable energy sources have a role to play, including Biomass. As we are rich in this resource and major part of our population having been dependent on biomass for meeting their energy requirements, the Ministry has been promoting a variety of biomass utilization technologies. The benefit available under the CDM has been providing additional incentives to such projects. India has been one of the major beneficiary to avail CDM benefits for renewable energy projects.

Q. 5. The Bioenergy magazine launched by your Ministry under the UNDP / GEF supported project is now into its second year of publication. Would you like to convey any special message to the readers of this magazine now that it is expected to serve as an agent of change amongst a wide spectrum of stakeholders?

**Ans.** The Bioenergy Magazine is an initiative taken to provide information about various activities and innovative projects taken up in the Biomass sector to all stakeholders. I would look forward to responses and suggestions and also to share their experiences to make the magazine more topical and relevant. Suggestions for my Ministry’s intervention in order to promote orderly growth of the biomass sector, particularly to provide energy and power in the rural areas are also welcome.
Towards Substantial Green Energy Supply In Karnataka 2020-2050

Biomass energy has tremendous potential to meet rural energy demands and only partial potential to meet urban energy demands. Biomass energy has distinctive advantages over other renewables like wind, sun and hydel, in terms of costs, despatchability and decentralisability. While wind, sun and hydel has a capital cost of ₹17 crores, ₹22 crores & ₹55 crores, respectively, per MW, biomass energy carries a capital cost of ₹5 crores to ₹7 crores per MW, for Rankine technology & gasification technology, respectively.

The State of Karnataka has the potential to generate nearly 5,000 MW of electricity from biomass, using both woody biomass and agricultural residues. Biomass energy generates nearly ₹2 crore incomes per year to the rural agrarian economy, through the purchase of biomass alone. In addition, there are other incomes to the rural economy in the growing, harvest and transport of biomass. There is no other capital investment of ₹5 to ₹7 crores, that can generate ₹2 crore income per annum, perpetually, to the rural economy.

Ideally, biomass power plants are to be located at the Gram Panchayat level, to meet the village’s entire energy demand and should ideally be of a capacity of 1 MW to 5 MW, depending on the energy load demand and the biomass availability in the vicinity of the village. Proximity to biomass catchment areas and the villages reduces the carbon footprints and cost of transport of biomass and facilitates availability of manpower from the village for O&M of the plant. Wind, sun and hydel being site specific, are located far away from inhabitations, limiting the easy availability of manpower to man the systems. In addition, since the transmission and distribution of biomass generated power is for short distances, for meeting the local rural loads only, the T & D losses are minimal. Ideally, the catchments and the distribution is to be in a radius of 25 kms from the power plant. In an event, if adequate biomass is not available, it can be grown in sufficient quantities, if feasible, based on availability of land. Alternately, generation capacity is to be limited to biomass availability, to ensure sustainability. If there is surplus biomass and generation, it can be sold to the grid or to third
Biomass energy in a decentralized manner, can provide good quality, reliable, dependable electricity services, 24x365, to our villages, for lighting, drinking water supply, irrigation, milling and cottage industry etc. Good quality, reliable and dependable electricity supply, 24x365, to villages, uplifts the rural economy. Provision of Urban Amenities in Rural Areas (PURA) villages can be developed through biomass energy reliable & quality electricity supply to villages is the start up for PURA villages. When self sufficient electricity is generated by biomass energy, for village use, the central grid system can be relieved of the burden of the rural load, using the base load electricity for urban applications.

There are 3,434 Gram Panchayats covering 33,026 electrified villages/hamlets in Karnataka. A biomass power plant of 1 MW to 5 MW capacity, for each Gram Panchayat, can provide round the clock electricity, to all the villages/hamlets in Karnataka. These villages/hamlets are suffering from acute power cuts due to power shortages in the state. The biomass power plants are to be managed by the Gram Panchayats, with adequate training to local youths in the O&M, if established with Government funding, or by the private sector if plants are established with private investment.

Ideally, the capacity for the entire village load is to be established in three or four phases, over a period of 12-15 years, to enable development of management skills in the Gram Panchayats as well as capacity building among the local youth for O&M of the plants. In addition, it will enable the accurate determination of the availability and the potential for growing biomass, for maintaining sustainability. It also enables setting up improvised systems which come up with technology upgradation, over a period of time.

Biomass energy in a decentralized manner, can provide good quality, reliable, dependable electricity services, 24x365, to our villages, for lighting, drinking water supply, irrigation, milling and cottage industry etc. Good quality, reliable and dependable electricity supply, 24x365, to villages, uplifts the rural economy.

Any biomass having a density of more than 250 kgs per cubic meter can be used for gasification. Rankine technology requires biomass of high calorific value. Often times, coal to the extent of 30% is to be blended with biomass to get the desired calorific values, reducing the carbon neutrality of the Rankine process. Besides, in the Rankine method, 7 MW capacity is found to be economically most feasible. 4 MW capacity is being tried out in two places in India. 2 MW capacity Rankine process is now just coming out into the Indian market.

Gasification technology, enables power generation even at sub MW levels, starting from 5 kW levels. The technology has developed very well since the last 25 years, and capacity to build gasifiers of upto 1.2 MW is now available in the country. Producer gas engines of indigenous manufacture of 250 kW and 644 kW are now available in India. Gasification power plants of 1 MW to 5 MW can be set up under one roof in a modular design. If one engine/reactor is shut down for maintenance, the other reactors/engines can continue generation in the modular design, thereby maintaining the supremacy of despatchability. Gasification is 100% carbon neutral. Even saw dust, paddy husk, peanut shell etc can be used for gasification by briquetting. Briquetting generates cottage industries in the rural areas. The species like Prosopis juliflora, Lantana camara etc., which grow wild on wastelands and unutilized lands can be used for gasification. Even bamboo, which is the fastest growing plant/grass in the world and Subabool, which can be cultivated on farm lands, can be used for gasification. There is no dearth of woody biomass or agri residues, in the country, for power generation. Biomass power is misunderstood as causing deforestation and is poorly marketed as it is not a multinational industry as yet, unlike wind and sun energy.

Biomass can be raised in plantations also. 15,000 tonnes of biomass is required for generating 1 MW year of electricity for a year. It is more economical and environmentally benign to harness the sun energy into biomass plantations and generate electricity than generate electricity.
industries are benefitting from their gasification electricity, with increased productivity, due to availability of biomass electricity at will. Wind and sun cannot provide electricity at will. Biomass energy, being a clean source of energy, is eligible for carbon credits. 1 kWh of biomass energy reduces 0.79 kgs of CO₂ emissions that would be generated by using coal, gas, oil energy. Industries have to invest in biomass gasification captive power plants on their own. There are subsidies from MNRE and availability of loans from IREDA for biomass power. Large farmers can also set up similar plants as biomass is available to them almost free of cost. However, since electricity is given free for up to 10 HP irrigation pump sets, most farmers will not be inclined to invest. However, carbon conscious farmers, may invest in biomass power, for voluntary reduction of emissions.

It is, however, the responsibility of the state to provide adequate power to the rural and urban areas, at costs, subsidised prices or free, in a welfare state. The industries will step in and set up gasification power plants for meeting rural load if adequate profit margins are available in the tariffs. At present, there is no separate tariff for gasification power in Karnataka. Rankine cycle tariff is applied to gasification power, which is not viable. Various groups are presently working on determining tariffs for gasification power. BERI experience indicates that a tariff of ₹6.00 per kWh leaves a reasonable margin in O&M gasification plants. Major costs are on biomass and labour. It remains to be seen whether the industry shows interest in setting up small sized biomass power plants in a distributed/decentralized manner.

A diesel generator set consumes 350 ml of diesel per kWh, costing nearly ₹14/- per kWh, at subsidized diesel prices. A diesel genset costs about ₹1.25 to ₹1.50 crores per MW. A gasification plant costs about ₹7 crore per MW. The operating cost in gasification is about ₹4.50 per kWh, where scope for multi-tasking labour is feasible, as in an industry. The cost of biomass power is not of much importance to the industry, as the cost is absorbed in increased productivity and in the end product of the industry. However, there is still savings in costs vis-a-vis diesel generation. The A gasification plant costs about ₹1.90 per kg. The Specific Fuel Consumption (SFC) for gasification is about 1.30 kgs per kWh. Similar plants of 1.2 MW capacity, modular design, are in operation in Tamil Nadu for captive generation of electricity for their industry during grid failure, which is common due to energy shortages. A ferro alloys industry in Andhra Pradesh has shown interest in gasification power plant and have consulted Biomass Energy for Rural India (BERI) and visited BERI sites.

For the urban areas, captive biomass gasification power plants are appropriate. An industry in Hosur has set up a 250 kW gasification power plant for meeting grid power shortages. This plant is operated for 8 hours a day, 6 days a week. They purchase woody biomass at ₹1.90 per kg. The Specific Fuel Consumption (SFC) for gasification is about 1.30 kgs per kWh. Similar plants of 1.2 MW capacity, modular design, are in operation in Tamil Nadu for captive generation of electricity for their industry during grid failure, which is common due to energy shortages. A ferro alloys industry in Andhra Pradesh has shown interest in gasification power plant and have consulted Biomass Energy for Rural India (BERI) and visited BERI sites.

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This mechanism to go off-grid from grid, whenever there is grid load shedding, the cluster villages would be getting round the clock biomass power, when rest of the villages suffer load shedding. This is proposed to be demonstrated in the summer of 2011.

BERI uses woody biomass for gasification. BERI has established 3,000 hectares of plantations on forest land and common lands and has also encouraged farm forestry in the jurisdiction, to meet the woody biomass requirement. The woody biomass from these plantations is used for generating power. The charcoal and ash residue from gasification is ploughed back into the soil in plantations/farmlands, thereby completing the carbon sequestration cycle. Charcoal and ash have excellent mulching properties, enabling increase in soil productivity. Till date, the BERI gasifiers have generated 4,41,765 kWh of green energy and has thus contributed to the reduction of nearly 350 tonnes of CO₂ emissions. The plantations established by BERI, has mitigated nearly 10,000 tonnes of carbon by sequestration. The UNDP has engaged a consultant to study and determine the carbon mitigation/sequestration by IPCC methodology. The report is expected soon. The consultant is also working on a paper on gasification tariffs. The CGPL, IISc is making a report on the performance of the 100 kW Kabbigere system, for publishing in scientific journals.

The urban and the urban industrial demand for power has to be met from base loads alone. Transporting biomass over long distances and in large quantities for meeting urban requirement is not feasible. Nuclear power will eventually have to replace power from fossil fuel like coal, oil and gas, in the distant future. Wind, sun and biomass has only decentralised applicability. The suitability of rooftop harnessing of wind and sun in urban areas, is to be assessed vis-a-vis the costs, site specificity, dispatchability and the carbon footprints in the manufacture and disposal of the required machinery and equipment. Hydel power plants submerge valuable biodiversity and wild life areas. Run of the river power plants, are seasonal, and generate power when hydel power is in surplus and when the agriculture load is minimal, due to monsoons. Wind and solar farms also require large areas of biodiversity and wild life habitats. Biomass energy is energy for all seasons and for all reasons.

The development and utilization of renewable energy sources has been accorded high priority by the Government of India. The policies and programs implemented by the Ministry of New and Renewable Energy have been successful in creating a large and diversified infrastructure to promote renewable energy, technologies in the country, including in rural areas. In spite of these efforts, renewable energy is still far away from the rural energy mainstream. But, there is a wind of change as several projects have been successfully implemented across the country based on renewable resources. Several NGO’s also have been successful in providing electricity through renewable sources in a number of villages across the country. Most importantly, a number of these projects have busted the myth that the rural people cannot afford and maintain technology and that it is not possible to run a commercial venture that fulfils a social objective. These renewable energy projects have touched the lives across the section of the society in rural as well as the urban areas.

A Compendium comprising of 26 such case studies based on various renewable energy technologies and devices, such as improved cook stoves, biogas plants for various applications, biomass gasifiers using different feedstock, solar photovoltaic lighting, solar thermal water heating systems and water mill from different parts of the country has been published by Ministry of New and Renewable Energy, in association with United Nations Development Programme and Swiss Agency for Development and Cooperation. This case study compendium was published as a document named ‘A glimpse of off-grid projects in India’. The focus of these case studies is on developing and implementing a sustainable delivery and revenue model. This publication was launched in a parallel workshop ‘Renewable Energy for Rural Empowerment’ highlighting on Access to Clean Energy organized during DIREC – 2010 to reach out to targeted stakeholders of the project.

Those interested to enrich their learning’s from the case studies can download it from the link given below: http://www.winrockindia.org/AcecaseStudies.htm
Hybrid Vermicompost Biodigesters – Empowering the Rural Households

Karnataka is one of the developed states of India and Bengaluru, the capital city of Karnataka is known as the Silicon Valley of India. However, the affluence is mostly concentrated in urban cities of Karnataka. Economy of rural Karnataka is still based on agriculture where food is still cooked using firewood on open fires and traditional inefficient stoves. Rural women and children have to spend at least two to three hours in a day for collecting firewood from nearby forests and other common lands. As more and more forests are depleting and common lands are being taken up for setting up industries or urban residential complexes, rural women are finding it difficult to gather firewood required for domestic use.
SKG Sangha (SKGS), a non-profit organization based in Kolar district of Karnataka is setting up hybrid Vermicompost biodigesters in rural Karnataka and in other states of India with the twin objectives of providing clean cooking gas generated through biogas to these rural areas and to enable the rural households to earn additional income by making saleable fertilizer from biogas residue and other unmanaged agricultural and domestic organic wastes.

The Process
The biogas is produced using cow dung. The biodigester built by SKGS consists of an underground brick built digester, an inlet at the ground level to feed the digester with new feedstock and two separate outlets to collect biogas and to remove the residue. Galvanized steel pipe is used to collect the gas from the plant and HDPE pipes are used to transport gas from the outlet to the biogas stoves in the kitchen. Cow dung mixed with equal amount of water is collected in the inlet tank which then flows into the digester due to gravitational force and displaces an equal volume of the residue, which gets collected in the residue tank constructed at the residue outlet of the plant. The biogas plant is constructed with locally available materials except for the gas burners and HDPE pipes.

SKGS builds biogas plants with a production capacity of 2, 3 and 4 m³ gas/day from an input of 50 to 100 kg cow dung from 2 to 6 cows.

Roughly 36 to 72 tons of output liquid residue is produced per year from 18 to 36 tons of wet feedstock. The residue can be directly used as a fertilizer but being in liquid form it cannot be transported to distant locations. In order to transform the liquid residue to easily portable organic manure, SKGS uses the vermiculature technique.

The vermicomposting unit comprises of two brick chambers of one cubic meter each with a concrete floor and a permanent roof. In this process, the liquid residue from the outlet reservoir tank is transferred to vermicomposting unit built at the ground level adjacent to the biogas plant. The residue is then mixed with fibrous material such as straw, green and/or dried leaves and the mixture is turned once in few days and allowed to decompose for 20 days. Then the earthworms are introduced on the mixture. The mixture is covered with straw or jute mat to avoid direct sunlight and to protect earthworms being eaten by birds, rats etc. A little water is added to the mixture to maintain the moisture. Every few days the top layer of the worm casts are scraped off and stored for using as vermicompost.

SKG Sangha has built and supplied over 80,000 biogas plants in rural areas of India. When a customer approaches SKGS for constructing a biogas plant, an assigned technician co-ordinates the work which includes arranging for the equipment and components required for installing the biogas plant, supervising the construction of biogas plants, checking the quality of construction, arranging for inspection by designated officials, training the villagers in plant operation, maintenance and management of the plant and maintaining the plant for its life time of more than 20 years.

Cost of a typical 2 m³ biogas plant comes about ₹18,000, overhead costs are about ₹2,000. Constructing the vermiculture system adds about another ₹12,000 to the total cost.

SKG Sangha currently has two business models. One to work through Government subsidies and the other one is to work through carbon money.

a) The business model with Government subsidies for installation of biogas plants: The Government of India gives subsidies for constructing approved models of biogas plants, which covers up to 50% of the total biogas plant. Customers pay the remaining 50% cost. Usually customers bear these expenses in kind by providing construction material like sand, gravel, and bricks; by taking part in the construction process and providing food to the construction workers etc. The cost of constructing the vermiculature unit has to be borne entirely by the customer either from his own pocket or through a loan from a bank or a micro finance institution.

b) SKGS also works on an alternative business model by utilizing the carbon money: In this model, SKGS conducts a base line survey of a selected project area and approaches a CER/VER buyer who is willing to pay upfront for the project. Once buyer
agrees to the condition, then SKGS selects the eligible women beneficiaries and conducts a series of meetings for the stakeholders and prepares them for the project. In this model, the CER/VER buyer pays up to 75% of the implementation cost of the hybrid system and the beneficiary pays 25% of the cost, which is usually given in the form of providing locally available building material like sand, metal chips, and labour etc.

Vermicompost production is a profitable income generating activity. Vermicompost is sold at ₹90 per 30 kg. Usually villagers keep 50% of the total vermicompost produced from their biogas and vermicompost units for self use and sell the remaining 50%. They earn around ₹12,000 per year by selling 50% of the vermicompost. With this income they are able to repay their loans and also have additional income to what they earn from their regular farm activities which is around ₹18,000 per year. SKGS also helps women beneficiaries in marketing the vermicompost, till they gain confidence of marketing their compost by themselves.

There is a huge demand for biogas plants and vermiculture units all over rural India.

According to Ministry of New and Renewable Energy statistics (2002), India has a potential of setting up of 12,000,000 biogas plants all over India and about 700,000 units in Karnataka alone. Similarly, the demand for vermicompost units is around 25,000,000 all over India and demand for the same in Karnataka is about 800,000.

Biogas plants have a positive impact on environment and health of the people. According to an estimate of a project on Clean Development Mechanism (CDM) project, carbon emissions can be reduced by about 4 tons/year by replacing the firewood cooking with biogas cooking.

Benefits of the Project

- As there is no smoke or soot produced while cooking with biogas, many respiratory and eye ailments caused due to smoke and soot generated during firewood cooking have been considerably reduced thus improving the health of the people especially among women and children.
- Cooking with biogas saves a lot of time for women as they need not spend time in collecting firewood, can cook food much faster. Even cleaning of utensils also takes less time as no soot gets collected on the utensils.
- Women are able to cook food before their children leave for school and as a result children are able to have breakfast at home and carry lunch to the schools. Since children are no more assisting in collection and processing of firewood and on hungry stomachs, they could concentrate on their studies at school.
- Biogas programs generate employment to local people thereby reducing urban migration.
- The vermicompost replaces chemical fertilizers which results in reducing import bill for the country.
- Vermicompost enriches the soil and results in better crop yields that give higher income to the farmers.
- Vermicompost reduces the use of chemical pesticides and this results in good health and lower investment on agriculture.
- Usage of vermicompost increases the water retention capacity of the soils - saving on power bills, conservation of the water resources.
- One of the major benefits is reducing the investment on agriculture which helps the farmer to lower the borrowings for agriculture investments.
- Gender equality can be achieved as these units are provided exclusively to women beneficiaries. Afterall, economic empowerment is social empowerment.
- Rural waste management can be achieved as the waste is input for these vermicompost units.
- Each hybrid vermicompost biodigester also saves about 6 tons of CO₂, helping to reduce the greenhouse gases in the atmosphere.

Although hybrid vermicompost biodigesters have been accepted by people, promotion and propagation of these units sometimes gets hindered because still majority of the population is not aware of these programs. There is a dearth of trained personnel who can install these units successfully and also difficulty in availing finances to install the biogas plants. If these issues are addressed by private and government institutions, then this programme can contribute in a major way in protecting the environment and making the society self reliant in renewable energy resources and agriculture.


CASE STUDY
Carbon Foot Printing – An Answer to Climate Threats – Focus on Agro Industries

Climate change is emerging as one of the great challenges towards modern society. In today’s commercial environment, organizations are liable to many risks out of which climate change is one. This impact of climate change upon businesses will grow significantly as governments adopt more progressive strategies in the coming years for encouraging efforts to reduce and manage carbon emission. Thus addressing, monitoring, managing and reducing carbon emissions, particularly where reductions in energy use are achieved, not only delivers great environmental benefits, but also results immediate cost savings.

Energy prices are likely to increase significantly over the next few years. Higher energy costs will increase the value of the energy that is saved. A carbon footprint identifies the opportunities for greater energy efficiency that ultimately cut cost and manages GHG emission.

Also, with the growing consumer awareness, companies that manage their carbon emissions responsibly can enhance their brand value. In addition, these days, investors are choosing to invest in and buy from those companies who are environmentally conscious. Managing resources, protecting an organization’s corporate reputation and controlling the cost of compliance with new regulations all make good business sense.

Carbon Footprint
A carbon footprint is the total set of GHG (greenhouse gas) emissions caused directly and indirectly by an individual, organization, event or product. In general, a carbon footprint considers all emissions of a product both backward in time from the point of consumption to emission sources and forward in time to include the use and disposal phase of products. Carbon footprinting, basically is a measure of the environmental impact of a particular individual or organization’s lifestyle or operation and is a useful exercise as part of a complete environmental management system. It is usually expressed in terms of carbon dioxide equivalent CO2 equivalent, which accounts for the different global warming effects of other greenhouse gases. By communicating its carbon footprint, an organization’s concern on the environment is made visible which would attract potential customers.

Carbon footprints are used to implement local policies in cities and regions that help in meeting national objectives. National carbon footprints help in designing efficient climate agreements that avoid shifting problems to other administrative territories.

Carbon Footprinting Approach
The method used for calculating carbon footprints is life cycle assessment (LCA) which is also referred as the ‘cradle-to-grave’ approach. It takes into account energy inputs and emission outputs throughout the process or product. This analysis is limited only to the emissions that have an effect on climate change.

Carbon footprint measurements of consumer products are based on bottom-up life-cycle assessment, while studies at the geographical level (city/region/nation) would apply top-down input-output analysis. No major players are involved in carbon footprinting except for the consultant. If a third party certification is carried out, then the certifying agency will be involved. Generally, carbon footprinting does not warrant the use of equipments in data collection. Data available with the client is sufficient most of the time.

Types of Carbon Footprint
In general, there are three types of carbon footprint: a) organizational carbon footprint, b) product carbon footprint (single product/activity/service), c) all activities and products through the supply chain.

An organizational carbon footprint deals with the entire activities of organization and it measures the GHG emissions from all the activities across the organization, including energy used in buildings, industrial processes and vehicles.

A product carbon footprint measures the GHG emissions over the whole life of a product (goods or services), from the extraction of raw materials and manufacturing right through its use and final re-use, recycling or disposal. In other words, GHG emissions outside the boundaries of the industrial/service activities are also considered in the project carbon footprint. This includes those of suppliers, customers and distributors.
related to the manufacture and use of the product. It also covers emissions created by disposing of any waste, and the impact of recycling.

Carbon footprint through the supply chain includes the GHG emissions right from the production of raw material until the usage of the product by the end user.

**Available Standards**

Greenhouse Gas Protocol, a corporate accounting and reporting standard, is the most widely used standard for greenhouse gas accounting and reporting. This protocol has been developed by the World Resources Institute and the World Business Council for Sustainable Development. Another standard is the Carbon Trust Standard, a voluntary certification scheme (originally developed for UK companies) for companies willing to demonstrate their commitment in reducing their carbon footprint. It is based on GHG protocol.

ISO 14064-1 is another standard for measuring and reporting greenhouse gas emissions at the organizational (as opposed to project) level. It is built on the key principles of Greenhouse Gas Protocol. This standard gives the specification and guidance for calculating the organization’s GHG emissions. ISO 14065 is a standard available for accreditation requirements for GHG assertions/claims. PAS 2050, which was published in October 2008, is the commonly used standard in product carbon footprint measurement. PAS 2050 is applicable to a wide range of goods and services. It gives guidance on how to treat emissions relating to issues such as recycling, renewable energy and land use change.

Legal Sector Alliance Protocol is another tool for measurement and accompanying guidance adapted from existing GHG Protocol measurement tools. UK Water Industry carbon accounting tool is a methodology and spreadsheet tool developed by UK Water Industry Research (UKWIR) to help individual water companies’ account for CO₂ emissions from their operations. In addition some industries have developed their own, industry-specific guidance for carbon footprinting. However, it has to be noted that these standards are not mandatory to follow. Carbon footprinting is typical for each specific case.

**Scopes of Carbon Footprinting**

Generally the scopes of carbon footprinting are classified as:
- **Scope 1** - direct emission
- **Scope 2** - indirect emission due to the generation of purchased electricity
- **Scope 3** - all other indirect emissions.

Direct emissions/scope 1 is the greenhouse gas emissions from sources that are owned or controlled by the reporting organization. Most of the direct emissions are due to combustion of fossil fuels in installations (e.g. boilers, turbines) or in mobile sources. It is necessary to report scope 1 if you apply the ISO standard or the GHG Protocol.

Indirect emissions/scope 2 is greenhouse gas emissions from imported power, electricity and heating or cooling. This is the energy which is consumed by the reporting organization, but generated elsewhere. It is mandatory to report scope 2 if the organization applies the ISO standard or the GHG Protocol.

Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

**Carbon footprints are used to implement local policies in cities and regions that help in meeting national objectives. National carbon footprints help in designing efficient climate agreements that avoid shifting problems to other administrative territories.**

**Frequency of Carbon Footprinting**

Carbon footprinting (CFP) can be done for one time or can be repeated every year. But the initial CFP is kept as benchmark and CFPs thereafter are carried out to verify the results and the credibility of the actions taken to reduce the CFP from the previous year.

**Steps in Carbon Footprinting**

Following are the steps involved in carbon footprinting:
- Decision on the method/procedure/standard to be followed
Carbon Footprinting in Agro Industries
Carbon footprinting of an agro industry starts from the growing of plant in the land to until delivery of products to the retailers and final disposal of residues. The carbon footprint of an agro product is the total amount of carbon dioxide (CO₂) and other greenhouse gases emitted over the life cycle of that product, expressed as kilograms of CO₂ equivalents.

It includes all greenhouse gases generated in the agricultural phase including emissions from the production and transportation of all inputs required for growing the crop, as well as emissions due to on-farm energy use and non-energy-related emissions (such as methane and nitrous oxide) from soils and livestock. It also includes the greenhouse gas emissions generated in the processing and packaging of agro products, and delivery to a point of sale or use location.

Finally, waste disposal all along the supply and consumption chain from the farm through processing, transport and consumption can add significantly to the carbon footprint of agro products.

Carbon Footprint Reduction Options in Agro industries
Power generation from agro industry residue and energy efficiency improvement in various processes of agro industries will reduce the carbon footprint of the product and contribute positively to the global environment.

Agro Industries have the biggest potential for biomass power generation and good potential for energy efficiency improvement. The agro industries residues in the form of biomass are considered as a fuel for power generation. The use of this type of biomass for power generation is considered as ‘carbon neutral’ because the CO₂ released by burning is equivalent to the CO₂ absorbed by the plants during their growth. However, other life cycle energy inputs affect this ‘carbon neutral’ balance, for example emissions arise from fertilizer usage, harvesting, transportation, processing and distribution.

The electricity generated from the agro residue reduces the carbon footprint of an agro industry by replacing the electricity which is generated from fossil fuels. In case of palm and sugar industries, the residues are used in cogeneration plants to meet their own requirements of steam and power. In case of rice and wood industries, there is a huge potential for power generation from residues. The energy generation from the residues will reduce the kg of CO₂/unit output of the product. Thus re-routing of agro residues for power generation ultimately contributes to the CO₂ mitigation and increases the value of the agro residue.

Identification of Boundary
The choice of the inventory boundary depends on the characteristics of the organization, the intended purpose of information and the needs of the users. The factors that should be considered when choosing an inventory boundary are organizational structures, operational boundaries and business context. Identification of organizational and operational boundary goes a long way in the successful conduct of a carbon footprint.

Reporting the Carbon Footprint
The GHG Protocol Corporate Standard and the ISO standards require reporting a minimum of scope 1 and scope 2 emissions. A carbon footprint report based on GHG protocol corporate standards consists of a) Required Information and b) Optional Information.

Required information is a public GHG emissions report that is in accordance with the GHG Protocol Corporate Standard, which includes description of the company with inventory boundary and information on emissions. Whereas optional information is a GHG emissions report which include the following additional information (if applicable) such as information on emissions and performance and information on offsets.

Conclusion
Carbon footprinting has many advantages to the organization including increase in export marketability value, enhancing the brand value and corporate reputation of the organization. It also identifies the opportunities for energy efficiency improvements and can identify areas of productivity increase which may result in substantial cost saving to the organization. It can also safeguard organizations from any stringent legislation in the future.

Identification of organizational and operational boundaries
Collection of data
Application of the emissions factors
Verification of the results
Devising a strategy to reduce emissions
Verification of the actions to reduce the emissions

Courtesies:
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Executive Director &
Arul Joe Mathias, Managing Director,
Renewable Cogen Asia
Email: balasankari@rcogenasia.com
How to Improve and Scale up Practices for Domestic Biogas Plants – Experiences and Successes in Nepal

Ram Maya Rijal of Thankot Village in Kathmandu district of Nepal had to wake up at 3 AM everyday and spend two hours collecting firewood. The smoky open fire in her kitchen was bad for her health and that of her family. And because each local household used three tonnes of wood a year for fuel, the forest she visited for firewood was getting smaller.

In the early 1990s, the Biogas Support Programme (BSP) was established by the Government of Nepal and SNV - Netherlands Development Organization to develop a market for domestic Biogas plants. These plants convert readily available animal manure into clean gas. The Rijals heard about biogas on Nepalese radio and invested in a plant themselves. Today, Ram Maya can cook cleanly and quickly, with no need to visit forest, which is recovering. And the nutrient-rich waste from her family’s biogas plant has increased the crop yields of their farm by 40%.

And that’s just one story. With more than 200,000 plants installed since its inception in 1992, Nepal’s Ashden Award-winning biogas program is now regarded as an international leader, with its business model — and its experts — used to start-up new programs in a number of developing countries around the world. Further, Nepal has successfully qualified for two Clean Development Mechanism (CDM) projects, the first carbon trades in the country. And while the overarching theme has been reaching rural, energy-poor and impoverished areas, the sector has also pursued socially inclusive actions via women-owned biogas companies. And at the heart of biogas is a commitment to public private partnerships, with more than 85 companies involved in the endeavour.

Operating in all 75 of the country’s districts and delivering direct and derivative benefits to well over one million people, biogas in Nepal is very much a national story of accomplishment. But in spite of the overall success of the BSP, only 20% of the total technical potential market has been reached. This is due to the geographical and socio-economic diversity of Nepal; lack of awareness about the benefits of the technology and the program; and costs of the plants due to inflation vis-à-vis lower purchasing power (coupled with limited access to finance).
The overall objective of the BSP is to further develop an efficient delivery network of services in the sector in order to disseminate biogas as an important renewable energy solution option in rural areas, while better addressing poverty, social inclusion and climate. At the same time, BSP will enhance credit access, efficiency and sustainability of the sector through decentralization, institutionalization and by emphasising the multiple benefits and further linking with livelihood issues like sanitation, access to clean energy and agricultural production.

Underlying the output of Nepal biogas is an emphasis on quality and user impact, checked through the Independent Annual Biogas Users' surveys, done in 300 to 500 randomly sampled plants of 1 to 8 years old. The most recent survey (2009) reveals the following:

- Around 93-98% of biogas plants are operational
- Around 74-89% of the plants use slurry in one or another form
- Around 11% of households also use gas produced for lighting
- Around 63-69% of the plants have been attached to toilets
- Around 91% of owners whose plants have crossed guarantee period are satisfied.

The constituent elements of Nepal’s success—the factors that have driven the sector to scale up/scale out practices—include a vibrant private sector, applied government guidance, donor commitment and a responsible program management entity.

The Alternative Energy Promotion Centre (AEPC), operating under Nepal’s Ministry of Environment, provides inputs and guidance relating to subsidy provision, government support and comparative tools from other renewable energy technologies. In addition, AEPC also developed and manages the Biogas Credit Unit, which provides loans that facilitate the market.

The BSP is the overarching entity that integrates activities ranging from monitoring of existing plants to users’ surveys to annual plans to research & development. Like many aspects of Nepal’s biogas sector, these deliverables are not undertaken in isolation but rather through cooperative activities, especially involving Nepal Biogas Promotion Association (NBPA).

The private sector comprises more than 85 companies overseen by NBPA. In addition to promoting the sector, NBPA places a premium on good governance among sector companies, helping to ensure transparency in practices, competitive pricing deliverance of quality through codes of conduct, monitoring and communication.

Donors and partners including German Development Bank, KfW, the World Bank, German Development Service (DED) and SNV Netherlands Development Organisation have played an important role in the sector. Donor support has underwritten portions of subsidy and program management costs, carbon project monitoring and verification and micro-credit development. Moreover, in the case of SNV, technical guidance is provided.

All the above mentioned links have converted the program into a great success. Figures speak the volumes even more. The total number of plants constructed under Nepal’s biogas program through July 2010 is 224,001. And the per-annum target for the next three years is 30,000. But with the overall successes of the program in Nepal, come challenges. The sector continues to pursue improvements to efficiency, economy and delivery. For instance, priority areas for BSP include enhancing availability and accessibility of microfinance; accelerating the path to CDM revenue; and migrating service delivery to the local level.

In addition, improvements to the comprehensive program monitoring are being developed. Meanwhile, over 5,000 masons and 1,500 supervisors...
have been trained under the program. But the retention ratio is roughly 30%. This trend must be reversed.

**Up-scaling to reach unreached families**

For the legacy of the program to continue, it certainly needs to be up-scaled while meeting the challenges. Some of the key features that will make up the up-scaling strategy include:

**Developing low-cost plant**

Due to geographic terrain and lack of transport facilities in remote areas, higher costs are incurred in the installation of a bio-digester. Inflation makes the situation worse. As a result, poorer households’ ability to install a bio-digester is diminished. Thus, innovation in technology development is required to help devise low-cost plants that will directly help reach poorer communities on a mass-scale.

**Enhancing access to finance**

Meeting the upfront cost that poor communities require to install a bio-digester in their backyard is a daunting task. However, access to credit facility eases this by giving room for payments on an installment basis for one to two years.

Credit availability for about one-third of total plants installed under the BSP from different microfinance institutions and cooperatives operating at the granular level have helped in bridging the gap to unreached families. A credit fund made available from KfW support to the Nepal Government has been the key factor in enhancing the access of poor families to biogas.

With considerable experience gained in biogas lending along with a good track record in loan repayments, now it is time for commercial banks to provide loan funds to microfinance institutions for biogas lending. This would certainly contribute to up-scaling the number of bio-digester installations in the days to come.

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**Request for Articles**

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

The magazine tries to bring an overall perspective by bringing out the experiences, information related to this key sector for a wider benefit of the Renewable Energy community. Bioenergy India therefore, 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 ₹ 1,500 each. Please send in your inputs along with relevant photographs to:

Varnana Sarkar (varnana@winrockindia.org)
Winrock International India: 788, Udyog Vihar, Phase V, Gurgaon-122 001; Phone: 0124-4303868
German Bioenergy Policy – A View from Indian Policy Perspective

Bioenergy covers more than 5% of the total primary energy demand of Germany. German renewable energy portfolio has more than two third energy generation contribution emanating from bioenergy. Table 1 summarizes how bioenergy contributed to different energy sector demands in the year 2007.

Table 1: Energy Sector Portfolio-Bioenergy

<table>
<thead>
<tr>
<th>Sector/Application</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity requirement</td>
<td>3.9</td>
</tr>
<tr>
<td>Heat requirement</td>
<td>6.1</td>
</tr>
<tr>
<td>Fuel requirement</td>
<td>7.3</td>
</tr>
</tbody>
</table>

As opposed to being used as blend in India, biodiesel is used most commonly as pure fuel in Germany. Since 2004, however, blending with diesel has been on the rise in Germany as well. A comparison was drawn to understand the differences in objectives between German and Indian bioenergy sector drivers. It is quite clear from table 2 that energy security, which is a primary concern in Indian bioenergy environment, takes a secondary seat in case of Germany. In the next section this policy comparison will highlight that in the early years of 1970’s, renewables were seen by the German Government as an energy security measure but towards 1990’s a shift was observed and climate change became the driver for renewable energy promotion.

Evolution and Growth of Bioenergy Policy

German Government’s support for renewable energy was initiated² by energy security concerns during the 1970s oil crises. Much in sync with most of the industrialized countries, the energy crises of 1973-74 and 1979-80 had severe economic impacts on Germany. Subsequently, renewable energy alternatives were promoted by the German Government as a potential measure for alleviating the risks associated with high cost fossil fuel imported from other countries. By the early 1990s, with rising environmental concerns of global climate change, promotion of renewables was no longer an energy security measure but a necessity to safeguard future. Germany, particularly has been a proponent of international policy.

Table 2: Objectives¹ Driving the Bioenergy Sector

<table>
<thead>
<tr>
<th>Country</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Climate Change</td>
</tr>
<tr>
<td>Germany</td>
<td>√</td>
</tr>
<tr>
<td>India</td>
<td>×</td>
</tr>
</tbody>
</table>

action to address climate change and has itself adopted a broad set of domestic actions to curtail its greenhouse gas emissions. Thus mitigating the effects of climate change primarily and securing sustainable energy secondarily are together now the key drivers of German Renewable Energy Policy.

Landmark legislation in German renewable energy policy in general and Biomass policy in particular came in the year 2007. In line with the European Council’s mandate from March 2007, a binding target of 20% power generation from electricity was set for 2020. Moreover, the targets set for 2020 aimed at reducing overall energy demand by 20% and increasing the share of renewable energy in fuel supply to 10%. It’s worth mentioning that the Council’s decision states that the 10% target is binding only when energy production is sustainable and commercial availability of second generation biofuels is assured.

On the contrary, Indian Biomass policy has not set any targets for electricity and has put up entire focus on transport sector by setting a mandate of 20% blending by 2017. Table 3 gives a comparative picture of targets of the two countries.

For providing proof that biomass crops are grown using sustainable management practices and biomass-derived products are produced in sustainable manner, standards and associated certification systems are proposed to be established at the national level.

In line with the ongoing debate in Indian bioenergy sector, German bioenergy policy while trying to achieve these goals will remain cognizant of the following:

- Biomass demand for energy production most often competes with food crop production
- Secondary products obtained from bioenergy production can play a key role in animal and food supply and must be explored with top priority

Current Strategy
For achieving the goals set in the bioenergy policy, according to a study conducted by the German Environment Ministry, a rise from 792 petajoules (PJ) in 2007 to 1,309 PJ in 2020 in the share of bioenergy in primary energy demand is required. In order to achieve this, a comprehensive strategy was designed by German Government which includes following six measures.

Sustainable biomass production
In order to take care of concerns of non-sustainable production leading to a loss of organic substances in the soil, requirements for good farming practices is set by German Government. These set of good farming practices provide binding rules which will ensure sustainable production irrespective of the type of the crops grown. Through these measures German Government aims at ensuring that domestic biomass production and use is sustainable. Moreover, for providing proof that biomass crops are grown using sustainable management practices and biomass-derived products are produced in sustainable manner, standards and associated certification systems are proposed to be established at the national level.

Alleviating land use conflict
Indian Biofuels Policy clearly enunciates use of waste land for

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Table 3: Targets

<table>
<thead>
<tr>
<th>Country</th>
<th>Targets (M = mandatory; V = voluntary)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electricity</td>
</tr>
<tr>
<td>Germany</td>
<td>12.5% by 2010, 20% by 2020 (M)</td>
</tr>
<tr>
<td>India</td>
<td>no targets</td>
</tr>
</tbody>
</table>

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biomass/biofuels production and doesn’t permit use of agricultural land to avoid food-fuel conflict. However, in Germany such explicit demarcation in use of land is not prescribed. There is in fact a growing competition for biomass and land on which biomass can be produced. For obtaining sustainable increase in biomass production on existing arable land, German Government is promoting the development of regionally adapted models for energy crop production. Incentives are in place under the Renewable Energy Sources Act (EEG). These incentives are aimed to foster greater use of unused organic waste. Rising energy prices on one hand and a visible increase in the use of renewable raw materials for energy production evolves the link between energy and food markets. It’s now being realized that crises in the energy sector and the associated frequent hike in crude oil prices will have a direct impact on food prices. The complex relationship between land use, food crops supply and the energy sector is being monitored by German Government as a part of the EU Renewables Directive. This directive stipulates a mandate for market players in the EU for documenting the production of biofuels and the availability of food.

**Heat from biomass**

Provisions of Renewable Energy Heat Act places obligation on owners of newly constructed buildings to use renewable energy for meeting certain portion of their heating requirement. The Act stipulates use of either or combined use of solar radiation, ambient heat, bioenergy and geothermal heat. The Act is however very clear that bioenergy may be used for heating purpose in buildings only if it is generated using highly efficient technology. Moreover, in place of renewable generated heat, the Act allows building owners to use combined heat and power (CHP) and energy saving measures provided the network is fed from a CHP plant. For deriving heat from biomass, the policy looks at the accompanying heat during generation of electricity using biomass which is under-utilized. The Policy also looks at restricting and reducing the risks from pollutants released during biomass-generated heat production. In addition to this an amendment to the regulations on small and medium-sized combustion plants (BlmSchV) has set emission standards for small-scale combustion plants.

**Electricity from biomass**

The amended Renewable Energy Sources Act (EEG) has evolved

### Table 4: Key Policy Instruments

<table>
<thead>
<tr>
<th>Country</th>
<th>Binding Targets/Mandates</th>
<th>Voluntary Targets</th>
<th>Direct Incentives</th>
<th>Grants</th>
<th>Feed in Tariffs</th>
<th>Compulsory Grid Connection</th>
<th>Sustainability Criteria</th>
<th>Tariffs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>E*, T</td>
<td>H</td>
<td>H</td>
<td>E</td>
<td>E</td>
<td>(E,H, T)</td>
<td>As EU</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>T, (E*)</td>
<td>E</td>
<td>E, H, T</td>
<td>E</td>
<td></td>
<td></td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

* E: electricity; H: heat; T: transport; Eth: ethanol
1 blending or market penetration
2 publicly financed incentives: tax reductions, subsidies, loan support/guarantees

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4 (Erneuerbare-Energien-Wärmegesetz, or EEWärmeG) came into effect on 1 January 2009
5 GBEP Report (2008)
changes in the biomass-generated electricity sector. One important provision involves incentives for fostering greater energy efficiency. Moreover, it promotes use of biogenic waste and waste substances. In the new Act, bonus on CHP has been considerably increased and the Act includes requirements for the use of heat generated during electricity production. The Act recommends transportation via the gas grid to supply heat or fuel, for use in CHP plants and in the transport sector. In this regard amendments have been done in Germany’s Gas Grid Access Ordinance (GasNZV), Gas Grid Payment Ordinance (GasNeV) and Incentives Ordinance (AregV). One of the most significant change is in the setting of a 6 percent target for 2020 and a 10% target for 2030 for Germany’s gas demand to be met with Bio-methane.

Biofuels
In the year 2004, the German Government evolved a strategy for biofuels taking into stock requirements for the year till 2020. This strategy takes a dual approach. At one end it aims at promoting innovation to increase the energy efficiency of engine technology and at other end tries to place energy supply for transport sector on a broader base in the long-term. Biofuels in this regard can play a key role. For achieving stipulated target for biofuels, biogenic oils which are hydrated together with mineral oil-derived oils in refinery processes will be counted as biofuels.

Other Measures
Keeping in mind the importance of research in expanding bioenergy sector and for realizing the targets set in the policy document, in 2008, the German Government opened the German Biomass Research Centre (DBFZ). DBFZ is envisioned to be developed as a centre of excellence for bioenergy research. This research will take place in collaboration with existing public research institutions already engaged in biomass research in the fields of agriculture, forestry, energy and environment. The DBFZ has been given the task of performing applied research on the use of agricultural and forest biomass for energy production. Mandated research activities range conditioning, biomass conversion to electricity, heat and fuel. The DBFZ is being funded by Federal Ministry of Food, Agriculture and Consumer Protection (BMELV).

Policy Instruments
Discussion on bioenergy policy and measures adopted by German Government to achieve it reveal a contrasting picture with Indian Biofuels Policy. As evident from table 4, focus of German Biomass policy is on sustainability criteria. Various amendments in existing laws and stringent regulatory provisions for criteria on sustainability issues of biomass production clearly support this. On the other hand, Indian Biofuels Policy has set binding targets for transport sector but doesn’t specifically look into sustainability issues. However, it would be wrong to say that Indian Biofuels Policy is not adhering to sustainability criteria. One reason why sustainability criteria doesn’t appear so explicitly in Indian Biofuels Policy is that by nature biofuels in India are designed to be derived from non-food crops produced in non-cultivable land.

Conclusion
Quite clearly, there exist many differences in the way Indian and German policies for bioenergy have evolved. While Indian Policy primarily looks at biomass as energy security measure, German biomass Policy treats it as an important measure to tackle climate change. Biomass cultivation and bioenergy policies also find a difference in their approach. On one hand, Indian Biofuels Policy explicitly focuses on non-food crops for energy plantation and mandates use of non-cultivable land for tree born oil (TBO) seeds, on the other hand German Bioenergy Policy, even though remains cognizant of food-fuel debate doesn’t debar use of arable land for energy plantations. Rather German policy relies more on technological improvement and prescribing certification and standards for sustainable biomass production. These differences quite clearly emanate from the techno-financial status of the two countries. India, on its rapid development agenda with still substantial population near poverty line is adopting more proactive approach in using bioenergy as an energy security measure, while Germany is trying to take climate change as priority. However, in spite of all these differences there can be many insights which Indian policy makers can derive from German Bioenergy Policy especially in the field of standards and best farming practices for energy plantations. Moreover, Indian Biofuels Policy can look at adopting policies from German Bioenergy Policy for utilizing combined heat from biomass.

Courtesy: Sharda Gautam, Program Associate, Winrock International India Email: sharda@winrockindia.org
Best Practices for Successful Deployment of Grid-Connected Renewable Projects in India

The power plants currently in operation in India rely heavily on sources such as coal that increase greenhouse gas (GHG) emissions. Part of the solution to mitigate overall emissions is the increased deployment of alternative energy projects. Viable alternative energy projects could offset the construction of more fossil-fuel-fired power plants, thus reducing further GHG production. However, there are serious barriers to renewable energy, distributed generation, cogeneration and combined heat and power deployment.

Major problems with building and operating renewable, distributed generation, cogeneration and combined heat & power (CHP) projects can be summarized as follows:

- Longer cost recovery period due to low tariff rates and higher development costs (for some technologies)
- Economic viability of projects given the need to recover higher development costs than conventional energy sources at regulated tariff prices
- Complicated and lengthy project approval processes
- Subsidies and cross-subsidies that mask the true cost of conventional energy
- Limited access to the transmission grid for the purpose of selling power to a wider consumer base
- Lack of interest by transmission utilities in extending the transmission network to the remote areas where most renewable energy projects are located
- Absence of grid connectivity standards and grid codes for renewable energy projects
First and foremost, the key issue with renewable energy projects is that their high capital cost (as compared to conventional systems) makes the project non-viable. The large upfront costs require high external financing that must be amortized over the life of the project. Developers usually find incentives are necessary to make alternative energy projects competitive with conventional energy sources and utilities also do not object to incentives as long as they do not affect the utility’s finances.

There are five general best practice design principles to follow when developing and implementing effective funding and incentive programs:

- Develop specific target markets and technologies based on technical and economic analyses
- Use funding and incentives as part of a broader policy to encourage renewable energy and cogeneration development
- Establish specific financial and technical criteria for investments in renewable energy and cogeneration
- Track and evaluate details of program participation, costs, savings, and production to improve the program and ensure goals are met
- Create a stable and long-term program (five years or more) to remove the barrier of uncertainty.

Types of incentives can vary but the most common are production tax credits, accelerated depreciation, capacity payments, demand credits, buy-down capital costs, carbon credits, and other tax incentives.

Issues related to Incentives

First and foremost, the key issue with renewable energy projects is that increasing the costs for developers and leading to higher risk and regulatory uncertainty.

Best Practices indicate that RPS percentages should increase slowly each year and should specify aggressive short and medium-term targets to establish stability and encourage investment. No maximum limits should be set; anything over the minimum RPS should be encouraged if economically viable. Heavy penalties for non-compliance will incentivize renewable development, but enforcement should be introduced gradually, especially when the RPS framework is still evolving.

The term “best practice” as used in this paper refers to practices that have been effective in the deployment of renewable energy and cogeneration. Effective policies and practices have a positive impact on a range of factors such as increased installed capacity, reductions in cost and price, technological advances, and public acceptance. One cannot advocate one “best practice” over another, nor does this paper necessarily contain all practices and policies that have been effective.

There are various policy, regulations, technical, financial, approval and contractual issues that need to be addressed when it comes to successful deployment of renewable projects, and best practices associated with each of them. This paper will cover the most critical issues related to renewable projects, and assess best practices associated with those issues.

Tariff Issues

One of the key issues to make a renewable project viable is the tariff at which power is sold to the grid.

Best Practices indicate that for developments like promotion of renewable energy, a fixed price for every unit of electricity produced by a renewable source that is usually above the tariff rate for conventional sources should be paid (Feed-in tariffs). They offer investors access to the grid and a fixed minimum price for electricity generated for a specified number of years, which often makes the project more viable. Either the tariff can be paid from a subsidy or the utility can pass the additional cost on to consumers. Investors have a reduced risk with feed-in tariffs as they are guaranteed a price for a fixed time at an economical rate. Furthermore, if a government wishes to support a new technology, it can require a tariff specific to that technology and thus encourage it to move closer to market. The balance of evidence suggests that this provides long-term benefits in terms of developing more competitive...
technologies. Tariff mechanisms have been widely applied in Europe, and have enjoyed particular success in Germany, Denmark, and Spain. Their employment in India also has led to significant increases in renewable electricity-generating capacity.

**REC Issues**
There are a number of different schemes to procure renewable energy including Renewable Energy Certificate (REC), where the portfolio standard or target is met with some form of certified renewable energy that is purchased or traded. An electricity supplier that generates electricity above its RPS can create RECs from the excess generation that can be sold to another entity or third party to meet its RPS requirements. If the market is properly designed, the transaction costs are low, and there is sufficient competition and price discovery, the REC scheme should achieve the required renewable energy capacity with the least possible impact on electricity consumers (REC mechanism has recently been formulated in Indian context). Best Practices for REC schemes are effective if they are:
- Efficient with low transaction costs
- Mandatory and enforceable.

**Intermittency and Grid Stability Issues**
Renewable energy resources are intermittent energy sources whose power output can vary widely, even within the hour, and potentially cause grid instability.

According to the best practices, one way to alleviate the problem of intermittency is to connect alternative energy facilities to the grid to enhance the reliability of the system. On a system with numerous small generating facilities, the loss of one generator will have a much smaller effect on the system. As more facilities connect to the system, intermittency becomes less of an issue.

**Approvals and Application Processing Issues**
Considerable disagreement exists between utilities and developers over what approvals should be required prior to interconnecting to the grid and the application process. The developer feels the approval and application processes are often lengthy and do not clearly define what tests and studies are needed. In addition, multiple agencies with jurisdiction over the project create delays and increase costs.

In India, different approvals are required for renewable energy projects of different types and sizes, and in some cases approvals from both Central and State governments are required in India. The project developer must obtain “no objection” certificates from several different government departments to obtain approval of the project. As a best practice, this could be streamlined by assigning the responsibility to energy development agency to obtain these certificates once the developer has provided sufficient project information.

As an example, since land, water, and the environment are the states’ responsibility, clearances relating to these issues have to be obtained from the relevant ministries of the state Government where the project is to be implemented. However, if part of the land happens to fall under the category of forest, clearances have to be obtained from both state and central Government ministries.

**Conclusion**
Before 2008, renewable energy projects were handled by the government on a case to case basis. With National Action Plan on Climate Change, the government initiated steps to promote renewable energy.

There are various stakeholders that play critical role in development of alternative energy projects, ranging from policy makers, utility executives, regulators, to project developers. These best practices can enable development of renewable energy projects to the extent required, so that the eleventh and upcoming five year plans achieve their capacity addition targets, thereby keeping up with 8% GDP growth of the country.

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** Courtesy: Abhinav Gupta  
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Developing India requires energy for economic growth and job creation. To achieve Millennium Development goals by 2015 and sustainable clean energy by 2030, an integrated approach to energy is essential. Despite the impressive growth in renewable energy adoption in the last five years, the challenge is that its share in the world’s primary energy supply remains small and its adoption uneven. The world has tapped only a small amount of the vast supply of renewable energy resources. For the upward trend of renewable energy growth to accelerate, technology development and policy efforts need to be taken to the next level, and large-scale private investment needs to be encouraged.

And for a developing country like India which is growing at a fast rate, the scenario becomes even more challenging because on one hand it has to attain its energy hunger for development and at the same time, it has to fashion its policies that aims towards more sustainable usage of energy resources.
The recently concluded Delhi International Renewable Energy Conference (DIREC) 2010 discussed spectrum of issues with an aim of up-scaling and mainstreaming renewables for energy security, climate change and economic development. And as the Conference proceeded with participation of ministers, energy experts and government representatives of 71 countries, the editorial team of Bioenergy India took a look at issues that were discussed, with a focus on Bioenergy.

There is not any element of doubt that for promoting the potential of bioenergy, one of the most viable renewable energy options for India— the most important beginning would be to include bioenergy friendly policies and facilitating adoption of bioenergy in industry and other sectors. Collaboration with research and academic institutions on joint projects in bioenergy can help take research and development further. Policy makers, financial institutions and development industry can serve as the one point expert source on bioenergy for creating a strong network of alliances with government, research and academic institutions, industries, technology centers and experts across the globe to facilitate cutting edge solutions in bioenergy.

Taking these issues into consideration a parallel workshop titled Bio-methanation: Up-scaling challenges and opportunities, was organized by MNRE and Swedish Embassy, SIDA, Swedish Energy Agency on the first day of the international conference. On the second day, a side event titled Considerations, Policies and Measures to Promote Sustainable Bioenergy Development organized by United Nations Environment Programme (UNEP) talked more on how Bioenergy can become integral in a country like India.

In the parallel workshop, Punjab Deputy Chief Minister Sukhbir Singh Badal stated that renewable energy should not be voluntary but mandatory. He stressed that India has immense potential to lead the way in association with Sweden and can adopt methods of renewable energy to overcome bio-environmental issues. The question that needs to be answered is that ‘can we afford it?’ He mentioned that the solution lies in ‘eco-isation’ of economy to make available renewable energy at comparative prices. He suggested that municipalities can contribute to solve environmental problems by helping convert waste to biogas. Citing the example of Sweden where not only biogas is generated but also purified, he said, biogas can be the innovative solution to this situation and India should look forward to an opportunity to partner with Sweden to improve our biogas production.

In the same workshop, N.C Majumdar from Ashoka Biogreen explained ‘The New Renaissance’. He stressed on the potential of waste like cow dung, poultry waste, municipal waste and sewage that can be converted into biogas which in turn can solve more than 50% energy requirement and 100% manure requirement with organic fertilizer. Citing example of the Digesters Technology- Nisargaruna Plant, he explained how biogas enrichment produced bumper crop which has been stored as buffer and the biogas has been upgraded to CNG standard with online gas analysis. Beside the stored biogas advantage another benefit would be smokeless villages in India.

He also explained that the climatic conditions in India are suitable for producing biogas through blending of technologies. However, he stated that the biggest obstacle in this whole project was the segregation of waste. He also mentioned that the only solution to the problem was to not mix waste while disposal and for the same, the municipality has to be advised not to collect non-bio-degradable waste from anywhere. He made the innovative suggestion of CNG
pipelines where enriched biogas can be injected for consumption and can be charged accordingly. This could be another source of income generation.

Speaking more on the same, Rajah Vijay Kumar, Group Chairman, Scalene Energy Research Institute (SERI), said the firm had created the world’s first serigas plant that generates power through biodegradable waste using specially designed bio-reactors. He also said that Scalene’s technology has the potential for utilization of both lower capacity household usage and higher capacity usage. He stated that fossil natural gas is formed in 200 million years while organic natural gas or biogas is formed in 7-10 days in Scalene Energy Research Institute’s serigas sparse-based power plant.

Another innovative technology using biogas was explained by V.K.Vijay from IIT Delhi, developed in Bhilwara, Rajasthan, India. He explained that biogas can be upgraded to auto mobile fuel. He gave the example of enriched biogas operated three wheeler vehicle, which is running successfully in the campus now. He also mentioned that there is a large potential for Indian villages for rural employment through sustainable energy.

Chandan Gadgil, from Innovative Environmental Technologies, mentioned about Biochemical Purification Technology for H₂S removal from biogas for power generation. He explained the “Bioskrubber”™ (Biological based Biogas Cleaning System) process with very high H₂S removal efficiency and no risk of fire/ explosion. He described this as a robust gas cleaning system tailor made for Indian conditions. Talking more, he said, so far there are 25 projects being undertaken in India with dedicated technical support team based in India to address client’s needs. There is also a clean sewage gas project in Delhi (at Rihala), which is the largest project on biogas with 5 MW of power in India. He also suggested the alternative application of biogas- BioCNG by upgradation, which is the first large-scale project with more than 15,000 cubic meters in India. He presented a good scope in synergizing new technologies for better sustainable energy production.

Ruchika Chawla from TERI presented a case study of India, SKG Sangh Developing Bio-gas Plant (this issue of Bioenergy India also documents SKG Sangh in the success story column). Anouj Mehta, ADB Representative, explained the financial aspect of biogas and stressed that it should be treated as business and not charity. There should be incentives for biogas power, relief of VAT and other taxes etc. He also suggested the subsidy could be provided for biogas energy. Suresh Rege from Mailhem Engineers, Pune, India also strongly recommended that policy should drive technology. He said that policies need to bring best and appropriate technology for higher capacities to produce efficient power generation. Stressing that there must be special incentives provided for better policy making, he raised the questions like – if subsidy is the right policy, is it for promoting the concept or for the project cost reduction and moreover what should be areas for subsidy-capital expenditure or maintenance and operation? When to give subsidy-on purchase, on completion, on continuation and regular efficient utilization and whether to give the subsidy to a financial promoter or technical provider also remains an important question? He concluded by asserting that it is important to give bold and pragmatic subsidy to ensure development.

In cities, canteen waste, animal waste and agro wastes are converted into biogas. This initiative is environment friendly, sustainable, economical and aesthetically inclined. The bioenergy production would put to use the waste from rural as well as urban centres and could help overcome bio-environmental issues. The challenge however is to invest in initial capital for setting up the project. The aim has to be not just current profit but energy saving as an investment for future. Bioenergy production can reduce expenditure of fossil fuels and prevent health hazards caused by traditional cooking fuels like coal/firewood, especially for women in rural India. So in every way, focused policy initiatives on bioenergy development puts India in a win-win situation.

It the sidelines of DIREC many similar events were held talked about other renewable forms and the barriers and advantages. The discussion during the event actually substantiated the fact that only by significant scaling-up of renewable energy that a country can enter the virtuous cycle of cost-reductions followed by more significant scaling-up. Supportive frameworks, procurement policies, a level playing field, providing access to affordable long-term finance, all can further help increase the uptake of renewable energy. The integration and mainstreaming of renewable energy into national sustainable development strategies for poverty reduction, agriculture, education, health and family welfare, can further provide more opportunities for scaling-up.
Haryana is a small state situated between 27°29’ to 30°56’ N latitudes and 74°27’ to 77°36’ E longitudes, covering an area of about 44,212 sq. km. It occupies 1.35% of the total area of the country having seventeenth position in area as compared with other states and Union Territories. The state imperceptibly slopes from north to south with height ranging from 200 to 900 m above mean sea level but the slopes become reverse in further south and south-west due to presence of the Aravalli Hills in the south. It mainly occupies the Indus-Gangetic water divide and forms a part of the Indus-Gangetic Alluvial Plain. The Siwaliks extend into its north-eastern corner, in which originate the present day seasonal rivers, viz. the Ghaggar, the Tangri, the Markanda and the Chautang, which flow taking a south-western course. The Aravalli Hills, which form a part of the peninsular shield, conspicuously appear in the southern extremity; in which originate the several ephemeral streams viz. the Sahibi and Dohan flowing from south to north.

The Aeolian tracts with sand dunal activities are common in the south, southwestern and western districts, in which outcrops of the Aravalli Hills occur intermittently. All the peripheral features have a distinct relief and have higher elevations than the Central structural basin, which represents a characteristically closed basin comprising flat alluvial plain. It is an agriculturally dominant state and about 88% of the total geographical area can be classified as cultivable while about 82% as net sown area.

The cropping intensity in the state is more than 150%, which indicates that the state has higher cropping intensity than the national average. The forest area in the state is very low which is mainly due to plain and levelled agriculture land available for the purpose of crop production throughout the state, except some hilly areas in northern and southern most parts of the state. The main food crops grown in Haryana are Bajra (Pennisetum typhoides), Paddy (Oryza sativa) Maize (Zea mays) during Kharif season and Wheat (Triticum aestivum) and Gram (Cicer arietinum) in Rabi season. Sugarcane (Saccharum officinarum), Cotton (Gossypium hirutetum), Rape and Mustard are important commercial crops. The flora of Haryana may be resembled to those of Iran, Arabia, and North Africa. The largest of the truly indigenous trees are Shisham (Dalbergia sisso) and Kikar (Acacia Arabica). The scrub jungle consists mostly of Jal (Salvadora oleoides), Jand (Prosopis specigera) and coral flowered leafless Karir (Caprylis aphylla). In the northern district of Ambala vegetation of sub-tropical, broad-leaved forest type is found and sub-tropical pine forests are found in the Siwaliks.

Geo-morphologically, following major units have been delineated in the state. These geomorphic units are Siwalik Hills, Piedmont, Yamuna flood plain, Ghaggar flood plain, Kaithal upland plain, Rohtak upland plain, Drishadavati plain with aeolian landform, Basin with Kankar, Fluvio-aeolian plain and Aravalli hills. Except some hills of the Siwalik system in the north and the Aravalli system in the south, the state has plain area having a height of 650 to 975 above mean sea level. The river Yamuna forms boundary between Haryana and U.P. for over 320 km., on the eastern side, whereas, Ghaggar flows on the north-west of the state. Soils in the state are mainly derived from these major geological units viz. extra peninsular region of Siwalik range, alluvial plains and peninsular part comprising district boundary Delhi and Rajasthan state in the south-east.

Bio-climatically, the Haryana state has been divided into five zones. These are hot and humid zones comprising parts of district Panchkula, Ambala, Yamunanagar, hot and sub-humid zone comprising of parts of Ambala, Yamunanagar, Kurukshetra and Kaithal; hot and semi-dry zone consisting of Kurukshetra, Karnal, Kaithal, Jind, Panipat, Sonipat, Gurgaon. Faridabad districts and parts of Rohtak district. Hot and dry zone comprising of Mahendragarh, Rewari and parts of Sirsa, Fatehaba, Hisar, Bhiwani, Rohtak and Gurgaon. Hot and arid zone consisting of parts of district Sirsa, Fatehabad, Hisar and Bhiwani. The mean annual rainfall varies from 1,000 mm in the north-eastern Siwalik Hilly tract to about 300 mm in the western extremity. The normal rainfall decreases from northeast to southwest in the state. The land use/land cover in Haryana can be broadly categorized into agriculture land, built-up land, forest/permanent vegetation, water bodies and others including wastelands.
Agricultural Biomass Assessment

Kharif Crops Biomass
Analysis of remote sensing data reflected that Paddy, Bajra and Cotton are the major crops followed by Sugarcane, Gwar and Jwar, which could be identified using multi-date remote sensing (RS) data. Other crops in the kharif season include Kharif pulses, Kharif oilseeds, Maize, Vegetables, fodder crops etc. Paddy is mostly concentrated in northern and north-eastern part and in north-western part of Ghaggar flood plain, Bajra, Jowar, Guar and Cotton in southern and south-western part of the state while Sugarcane in northern, north eastern part of the state. Higher concentration of Sugarcane was in flood plain of Yamuna river. RS estimation showed that Rice, Bajra, Cotton, Sugarcane, Gwar and Jwar covered 1,080.17, 482.94, 138.99, 98.92 and 80.79 thousand hectares which is closely matched with what obtained from Department of Agriculture estimates for the same year 2007-08. During Kharif season total cropped area, total biomass, non-grain biomass, basic surplus biomass, net surplus biomass, power generation potential from basic and net surplus biomass was 2,509.76 thousand hectares, 24,795.86 thousand tonnes, 6,696.62 thousand tonnes, 6,109.45 thousand tonnes, 730.88 respectively. No basic and net surplus biomass for Sugarcane and Jwar was not available in the state. Crop-wise crop area, total biomass, non-grain biomass, basic surplus, net surplus, power generation potential from basic and net surplus in the state is depicted in Table 1.

District-wise crop area, total biomass, non-grain biomass, basic surplus, net surplus, power generation potential from basic and net surplus biomass respectively. Geographically, these are contiguous districts and therefore, offer scope for power plants. Among kharif crops, the maximum non-grain/non-economic surplus biomass is available from Paddy crop as its straw is not used for fuel or fodder purposes. No surplus biomass is available for Sugarcane and Jwar crop.

Rabi Crops Biomass
Wheat and Mustard are the major crops during rabi season followed by Gram which could be identified using multi-date RS data. Barley is a minor crop and not discriminable on satellite data from wheat due to its structural similarity with wheat. Hence, the area has been used provided by Department of Agriculture. The other crops, grown in the state during rabi season are other Rabi pulses, vegetables and fodder etc. Wheat crop is spread throughout the state except in southern, south-western and western sandy part where concentration of mustard and gram is more and these crops occupy 2,433.73, 498.69, 95.81 thousand hectare area, respectively in the state. Barley is grown along with wheat and occupies 40.50 thousand hectares.

Remote sensing based area estimation for different crops showed a close proximity with what was reported by Department of Agriculture for the same year. During Rabi season total cropped area, total biomass, non-grain biomass, basic surplus biomass, net surplus biomass, power generation potential from basic and net surplus biomass was 3,068.73 thousand hectares, 3,068.73 thousand tonnes, 2,307.04 thousand tonnes, 1,019.89 and 288.07 MW respectively. Crop-wise crop area, total biomass, non-grain biomass, basic surplus, net surplus, power generation potential from basic surplus biomass, power generation potential from net surplus biomass is depicted in Table 1.

Table 1: Kharif Season Biomass Crops derived from RS data

<table>
<thead>
<tr>
<th>Crop</th>
<th>Area (‘000 ha.)</th>
<th>Total biomass (‘000 t)</th>
<th>N.G./N.E. biomass (‘000 t)</th>
<th>Basic surplus biomass (‘000 t)</th>
<th>Net surplus biomass (‘000 t)</th>
<th>Power generation potential from basic surplus (MW)</th>
<th>Power generation potential from net surplus (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy</td>
<td>1,080.17</td>
<td>9,271.57</td>
<td>5,655.66</td>
<td>5,220.03</td>
<td>5,220.03</td>
<td>612.82</td>
<td>612.82</td>
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<tr>
<td>Cotton</td>
<td>482.94</td>
<td>801.62</td>
<td>480.97</td>
<td>376.56</td>
<td>376.56</td>
<td>53.09</td>
<td>53.09</td>
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<tr>
<td>Sugarcane</td>
<td>138.99</td>
<td>9,911.49</td>
<td>1,486.72</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Bajra</td>
<td>627.94</td>
<td>4,350.82</td>
<td>3,176.10</td>
<td>994.33</td>
<td>456.11</td>
<td>129.26</td>
<td>59.29</td>
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<tr>
<td>Jwar</td>
<td>80.79</td>
<td>157.87</td>
<td>121.56</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Gwar</td>
<td>98.92</td>
<td>302.5</td>
<td>187.55</td>
<td>105.7</td>
<td>56.75</td>
<td>10.57</td>
<td>5.67</td>
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<tr>
<td>Total</td>
<td>2,509.76</td>
<td>24,795.86</td>
<td>11,108.56</td>
<td>6,696.62</td>
<td>6,109.45</td>
<td>805.74</td>
<td>730.88</td>
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</table>

(NG/NE – Non-grain/Non-economic)
Table 2: District-wise Kharif Season Biomass Crops derived from RS data

<table>
<thead>
<tr>
<th>District/Parameter</th>
<th>Area (000 h)</th>
<th>Total biomass ('000 t)</th>
<th>N.G./N.E. biomass ('000 t)</th>
<th>Basic surplus biomass ('000 t)</th>
<th>Net surplus biomass ('000 t)</th>
<th>Power generation potential from basic surplus (MW)</th>
<th>Power generation potential from net surplus (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hisar</td>
<td>254.01</td>
<td>1,281.18</td>
<td>762.47</td>
<td>322.60</td>
<td>278.48</td>
<td>39.48</td>
<td>34.49</td>
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<td>Fatehabad</td>
<td>168.71</td>
<td>1,138.76</td>
<td>650.21</td>
<td>548.88</td>
<td>540.31</td>
<td>66.21</td>
<td>65.36</td>
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<tr>
<td>Sirsa</td>
<td>254.54</td>
<td>912.80</td>
<td>560.55</td>
<td>481.25</td>
<td>465.70</td>
<td>59.48</td>
<td>57.92</td>
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<td>Bhiwani</td>
<td>260.11</td>
<td>1,289.18</td>
<td>832.11</td>
<td>315.67</td>
<td>170.46</td>
<td>40.57</td>
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<td>Rohtak</td>
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<td>1,263.53</td>
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<td>540.31</td>
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<td>34.49</td>
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<td>200.51</td>
<td>81.77</td>
<td>58.56</td>
<td>54.12</td>
<td>7.07</td>
<td>6.50</td>
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<td>Palwal</td>
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<td>239.40</td>
<td>170.96</td>
<td>113.02</td>
<td>111.15</td>
<td>111.15</td>
<td>111.15</td>
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<td>Panipat</td>
<td>88.46</td>
<td>1,263.53</td>
<td>650.21</td>
<td>548.88</td>
<td>540.31</td>
<td>66.21</td>
<td>65.36</td>
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<td>Karnal</td>
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<td>2,643.38</td>
<td>1,137.19</td>
<td>946.80</td>
<td>946.80</td>
<td>111.15</td>
<td>111.15</td>
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<td>Kurukshetra</td>
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<td>842.03</td>
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<td>1,023.64</td>
<td>744.66</td>
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<td>93.76</td>
<td>1,643.17</td>
<td>589.44</td>
<td>394.54</td>
<td>394.54</td>
<td>46.35</td>
<td>46.35</td>
</tr>
<tr>
<td>Panchkula</td>
<td>8.90</td>
<td>86.07</td>
<td>43.81</td>
<td>34.52</td>
<td>34.52</td>
<td>4.05</td>
<td>4.05</td>
</tr>
<tr>
<td>Yamuna Nagar</td>
<td>104.73</td>
<td>2,943.18</td>
<td>731.18</td>
<td>299.67</td>
<td>299.67</td>
<td>35.22</td>
<td>35.22</td>
</tr>
<tr>
<td>Jind</td>
<td>192.77</td>
<td>1,510.70</td>
<td>818.08</td>
<td>554.24</td>
<td>402.37</td>
<td>67.92</td>
<td>67.92</td>
</tr>
<tr>
<td>Mahendergarh</td>
<td>113.22</td>
<td>694.61</td>
<td>500.59</td>
<td>57.89</td>
<td>57.89</td>
<td>57.89</td>
<td>57.89</td>
</tr>
<tr>
<td>Rewari</td>
<td>71.45</td>
<td>400.38</td>
<td>290.63</td>
<td>36.49</td>
<td>32.21</td>
<td>4.70</td>
<td>4.15</td>
</tr>
<tr>
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<td>2,509.76</td>
<td>24,795.86</td>
<td>11,108.56</td>
<td>6,696.62</td>
<td>6,109.45</td>
<td>805.74</td>
<td>730.88</td>
</tr>
</tbody>
</table>

Table 3: Rabi Season Biomass Crops derived from RS data

<table>
<thead>
<tr>
<th>Crop</th>
<th>Area ('000 ha.)</th>
<th>Total biomass ('000 t)</th>
<th>N.G./N.E. biomass ('000 t)</th>
<th>Basic surplus biomass ('000 t)</th>
<th>Net surplus biomass ('000 t)</th>
<th>Power generation potential from basic surplus (MW)</th>
<th>Power generation potential from net surplus (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>2,433.73</td>
<td>24,145.55</td>
<td>14,004.42</td>
<td>6,702.63</td>
<td>1,208.36</td>
<td>871.34</td>
<td>157.09</td>
</tr>
<tr>
<td>Mustard</td>
<td>498.69</td>
<td>2,045.18</td>
<td>1,431.63</td>
<td>1,093.68</td>
<td>1,093.68</td>
<td>130.33</td>
<td>130.33</td>
</tr>
<tr>
<td>Gram</td>
<td>95.81</td>
<td>121.30</td>
<td>86.12</td>
<td>68.52</td>
<td>68.52</td>
<td>8.91</td>
<td>8.91</td>
</tr>
<tr>
<td>Barley</td>
<td>40.50</td>
<td>292.26</td>
<td>175.35</td>
<td>71.64</td>
<td>5.00</td>
<td>9.31</td>
<td>0.65</td>
</tr>
<tr>
<td>Total</td>
<td>3,068.73</td>
<td>26,604.28</td>
<td>15,697.52</td>
<td>7,936.47</td>
<td>2,307.04</td>
<td>1,019.89</td>
<td>288.07</td>
</tr>
</tbody>
</table>

The top 10 districts comprising Sirsa, Karnal, Bhiwani, Fatehabad, Sonipat, Hisar, Panipat, Jhajjar, Kaithal and Jind contribute nearly 62% of the total power generation potential in the state using basic surplus biomass. The top 10 districts comprising Sirsa, Rewari, Bhiwani, Hisar, Jhajjar, Fatehabad, Palwal, Gurgaon, Karnal and Kurukshetra contribute nearly 77% of the total power generation potential in the state using net surplus biomass. Geographically, these are contiguous districts and therefore, offer scope for power plants. Among kharif crops maximum non-grain/non-economic surplus is available for Wheat crop. But it is clear from the data that most of the non-grain/non-economic surplus biomass of rabi crops has been utilized mainly for fodder and other domestic uses.
purposes by the farmers. Therefore, though the basic surplus biomass during rabi season is higher compared to Kharif but net surplus is very less. The surplus biomass is available in the areas where the land holding is high and crop was harvested using combine harvester.

**Total Agricultural Biomass**

The state has major crops Paddy, Bajra, Cotton followed by Sugarcane, Gwar, Jwar and Wheat, Mustard followed by Gram, Barley during kharif and rabi seasons respectively. Area of Rabi crops 3,068.73 thousand ha. is quite high as compared to kharif crops 2,509.75 thousand ha. Inspite of significant higher area of rabi crops its total biomass is comparable with kharif crops’ total biomass (Table 5).

Table 4. District-wise Rabi Season Biomass Crops derived from RS data

<table>
<thead>
<tr>
<th>District/Paramet.</th>
<th>Area (000 h)</th>
<th>Total biomass ('000 t)</th>
<th>N.G./N.E. biomass ('000 t)</th>
<th>Basic surplus biomass ('000 t)</th>
<th>Net surplus biomass ('000 t)</th>
<th>Power generation potential from basic surplus (MW)</th>
<th>Power generation potential from net surplus (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hisar</td>
<td>288.37</td>
<td>2,333.92</td>
<td>1,379.26</td>
<td>531.16</td>
<td>174.57</td>
<td>68.19</td>
<td>21.83</td>
</tr>
<tr>
<td>Fatehabad</td>
<td>199.26</td>
<td>2,128.97</td>
<td>1,240.97</td>
<td>637.57</td>
<td>104.70</td>
<td>82.68</td>
<td>13.41</td>
</tr>
<tr>
<td>Sirsa</td>
<td>329.36</td>
<td>2,983.67</td>
<td>1,757.16</td>
<td>924.03</td>
<td>569.92</td>
<td>119.43</td>
<td>73.39</td>
</tr>
<tr>
<td>Bhiwani</td>
<td>357.81</td>
<td>1,866.23</td>
<td>1,146.24</td>
<td>664.86</td>
<td>183.97</td>
<td>84.46</td>
<td>21.94</td>
</tr>
<tr>
<td>Rohtak</td>
<td>114.69</td>
<td>863.76</td>
<td>506.51</td>
<td>361.63</td>
<td>25.63</td>
<td>46.73</td>
<td>3.05</td>
</tr>
<tr>
<td>Jhajjar</td>
<td>138.16</td>
<td>1,075.33</td>
<td>644.44</td>
<td>413.58</td>
<td>135.72</td>
<td>52.71</td>
<td>16.59</td>
</tr>
<tr>
<td>Sonipat</td>
<td>142.89</td>
<td>1,444.47</td>
<td>839.24</td>
<td>601.21</td>
<td>22.54</td>
<td>78.08</td>
<td>2.85</td>
</tr>
<tr>
<td>Gurgaon</td>
<td>67.86</td>
<td>562.26</td>
<td>335.04</td>
<td>146.43</td>
<td>91.81</td>
<td>18.49</td>
<td>11.39</td>
</tr>
<tr>
<td>Mewat</td>
<td>102.28</td>
<td>752.18</td>
<td>453.07</td>
<td>268.73</td>
<td>154.85</td>
<td>33.91</td>
<td>19.10</td>
</tr>
<tr>
<td>Faridabad</td>
<td>37.95</td>
<td>395.66</td>
<td>230.63</td>
<td>84.41</td>
<td>34.87</td>
<td>10.93</td>
<td>4.49</td>
</tr>
<tr>
<td>Palwal</td>
<td>96.51</td>
<td>1,023.17</td>
<td>595.03</td>
<td>272.75</td>
<td>98.05</td>
<td>35.38</td>
<td>12.67</td>
</tr>
<tr>
<td>Panipat</td>
<td>84.13</td>
<td>867.58</td>
<td>503.53</td>
<td>430.25</td>
<td>13.46</td>
<td>55.91</td>
<td>1.73</td>
</tr>
<tr>
<td>Karnal</td>
<td>172.55</td>
<td>1,900.67</td>
<td>1,102.72</td>
<td>693.70</td>
<td>87.48</td>
<td>90.18</td>
<td>11.37</td>
</tr>
<tr>
<td>Kurukshetra</td>
<td>110.59</td>
<td>1,257.35</td>
<td>729.58</td>
<td>295.20</td>
<td>87.36</td>
<td>38.38</td>
<td>11.36</td>
</tr>
<tr>
<td>Kaithal</td>
<td>170.97</td>
<td>1,820.58</td>
<td>1,056.32</td>
<td>321.13</td>
<td>16.52</td>
<td>41.73</td>
<td>2.13</td>
</tr>
<tr>
<td>Ambala</td>
<td>82.23</td>
<td>747.32</td>
<td>433.68</td>
<td>239.04</td>
<td>11.88</td>
<td>31.07</td>
<td>1.54</td>
</tr>
<tr>
<td>Panchkula</td>
<td>16.62</td>
<td>120.18</td>
<td>70.26</td>
<td>34.70</td>
<td>2.72</td>
<td>4.49</td>
<td>0.33</td>
</tr>
<tr>
<td>Yamuna Nagar</td>
<td>76.75</td>
<td>687.55</td>
<td>399.55</td>
<td>67.46</td>
<td>4.36</td>
<td>8.72</td>
<td>0.52</td>
</tr>
<tr>
<td>Jind</td>
<td>219.31</td>
<td>2,155.44</td>
<td>1,252.63</td>
<td>320.90</td>
<td>42.16</td>
<td>41.58</td>
<td>5.35</td>
</tr>
<tr>
<td>Mahendergarh</td>
<td>143.58</td>
<td>766.42</td>
<td>484.84</td>
<td>293.45</td>
<td>211.48</td>
<td>35.86</td>
<td>25.20</td>
</tr>
<tr>
<td>Rewari</td>
<td>116.87</td>
<td>851.59</td>
<td>536.83</td>
<td>334.25</td>
<td>233.00</td>
<td>40.99</td>
<td>27.82</td>
</tr>
<tr>
<td>State</td>
<td>3,068.73</td>
<td>26,604.28</td>
<td>15,697.52</td>
<td>7,936.47</td>
<td>2,307.04</td>
<td>1,019.89</td>
<td>288.07</td>
</tr>
</tbody>
</table>

Table 5: Total Biomass Crops derived from RS data

<table>
<thead>
<tr>
<th>Crop Season/Parameter</th>
<th>Total biomass ('000 t)</th>
<th>N.G./N.E. biomass ('000 t)</th>
<th>Basic surplus biomass ('000 t)</th>
<th>Net surplus biomass ('000 t)</th>
<th>Power generation potential from basic surplus (MW)</th>
<th>Power generation potential from net surplus (MW)</th>
<th>Total biomass ('000 t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kharif</td>
<td>2,509.75</td>
<td>24,795.83</td>
<td>11,108.54</td>
<td>6,696.61</td>
<td>6,109.44</td>
<td>805.74</td>
<td>730.88</td>
</tr>
<tr>
<td>Rabi</td>
<td>3,068.73</td>
<td>26,604.28</td>
<td>15,697.52</td>
<td>7,936.47</td>
<td>2,307.04</td>
<td>1,019.89</td>
<td>288.07</td>
</tr>
<tr>
<td>Total</td>
<td>5,578.48</td>
<td>51,400.12</td>
<td>27,806.06</td>
<td>14,633.07</td>
<td>8,416.47</td>
<td>1,825.64</td>
<td>1,018.95</td>
</tr>
</tbody>
</table>
tonnes), 1,825.64 and 1,018.95 MW respectively. District-wise crop area, Total biomass, non-grain biomass, basic surplus, net surplus, power generation potential from basic and net surplus is depicted in Table 6.

The basic surplus biomass available after the consumption of domestic use and subtraction of sugarcane biomass and sold by the farmers for Wheat, Gram, Barley, Bajra and Jwar is 8,416.47 thousand tonnes. The total power generation potential from this biomass is 1,018.95 MW.

The top 9 districts comprising Karnal (201.33), Sirs (178.9), Fatehabad (148.89), Kaithal (129.15), Sonipat (114.21), Kurukshetra (111.09), Jind (109.51), Bhiwani (125.03), and Hisar (107.67) MW, contribute nearly 67.18% of the total power generation potential in the state using basic surplus biomass. Geographically, these are contiguous districts and therefore, offer scope for power plants. The top 9 districts comprising Karnal (122.52), Sirs (131.31), Fatehabad (78.76), Kaithal (89.55), Sonipat (38.99), Kurukshetra (84.03), Jind (53.53), Bhiwani (43.63), and Hisar (56.52) MW contribute nearly 68.49% of the total power generation potential in the state using net surplus biomass. Geographically, these are contiguous districts and therefore, offer scope for power plants. The power generation potential was significant in the group of above mentioned districts using basic as well as net surplus biomass.

*Source: Biomass Resource Atlas, HAREDA*

<table>
<thead>
<tr>
<th>District/Parameter</th>
<th>Area (000 ha)</th>
<th>Total biomass ('000 t)</th>
<th>N.G./N.E. biomass ('000 t)</th>
<th>Basic surplus biomass ('000 t)</th>
<th>Net surplus biomass ('000 t)</th>
<th>Power generation potential from basic surplus (MW)</th>
<th>Power generation potential from net surplus (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hisar</td>
<td>542.38</td>
<td>3,615.10</td>
<td>2,141.73</td>
<td>853.77</td>
<td>453.05</td>
<td>107.67</td>
<td>56.32</td>
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<tr>
<td>Fatehabad</td>
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<td>980.53</td>
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<td>125.03</td>
<td>43.63</td>
</tr>
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<td>Rohtak</td>
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<td>517.48</td>
<td>161.83</td>
<td>66.01</td>
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</tr>
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<td>624.03</td>
<td>390.70</td>
<td>267.87</td>
<td>49.48</td>
<td>33.51</td>
</tr>
<tr>
<td>Faridabad</td>
<td>55.25</td>
<td>596.17</td>
<td>312.40</td>
<td>142.98</td>
<td>88.99</td>
<td>18.00</td>
<td>10.99</td>
</tr>
<tr>
<td>Palwal</td>
<td>145.70</td>
<td>1,645.45</td>
<td>833.17</td>
<td>430.71</td>
<td>248.96</td>
<td>54.34</td>
<td>30.71</td>
</tr>
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<td>936.27</td>
<td>717.84</td>
<td>301.05</td>
<td>89.68</td>
<td>35.49</td>
</tr>
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<td>89.55</td>
</tr>
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<td>47.89</td>
</tr>
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<td>Panchkula</td>
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<td>114.07</td>
<td>69.22</td>
<td>37.24</td>
<td>8.54</td>
<td>4.38</td>
</tr>
<tr>
<td>Yamuna Nagar</td>
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<td>1,130.73</td>
<td>367.13</td>
<td>304.04</td>
<td>43.95</td>
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</tr>
<tr>
<td>Jind</td>
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<td>875.13</td>
<td>444.53</td>
<td>109.51</td>
<td>53.53</td>
</tr>
<tr>
<td>Mahendergarh</td>
<td>256.80</td>
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<td>985.43</td>
<td>351.34</td>
<td>212.11</td>
<td>43.39</td>
<td>25.29</td>
</tr>
<tr>
<td>Rewari</td>
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<td>1,251.97</td>
<td>827.46</td>
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<td>265.21</td>
<td>45.69</td>
<td>31.97</td>
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<tr>
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<td>51,400.12</td>
<td>26,806.06</td>
<td>14,633.07</td>
<td>8,416.47</td>
<td>1,825.64</td>
<td>1,018.95</td>
</tr>
</tbody>
</table>
Can all Biomass be Treated Equal?

Referred to by some as the fourth energy source, biomass undoubtedly has the potential to contribute towards reducing the world’s dependency on fossil fuels. However, not all types of organic material are equal and available in abundant quantities and at the moment existing energy policy does not recognise this. Wood is a case in point. As a fuel it is attractive because it has a calorific value greater than most other biomass types, it is perceived as being present in abundance and there are established supply chains. These are just a few reasons as to why it is seen as the fuel of choice by the majority of dedicated biomass fired electricity generators. But is it the right direction for biomass policy to be heading?

Those who already use wood, such as the wood panel industry certainly do not think so. The Renewables Obligation (RO) policy, which is driving the move towards renewable electricity in the UK, does not differentiate between fuel types. Instead it focuses attention on technologies. The RO works by obligating the licensed electricity suppliers to source a specified percentage of their electricity supply from renewable sources. Any shortfall in that attainment has to be made up by paying a minimum buyout price per MWh of shortfall. This ‘tax’ is then re-circulated via tradable certificates (ROCs) to the generators, which can use this indirect subsidy to invest in renewable electricity generation capacity. The level of support is banded according to technology types. An argument against the RO is that it is a blunt instrument that works well for the likes of wind generation, where the subsidy is used to support capital and distribution costs. However, in respect of biomass, the bulk of the subsidy is used to support bringing the fuel to the generators gate and as such the RO actually has some perverse consequences. In particular, the RO encourages the cherry picking of biomass fuel types in favour of those that will generate greatest profit for the generators, rather than focusing on those fuel types that will in the long run actually lead to the best environmental returns such as short rotation crops, energy crops and energy from waste.

Carbon balance (accounting) studies highlight the point that whilst biomass is generally carbon neutral over its lifecycle, because trees have a relatively long lifecycle (typically 40 years European softwoods) net CO₂ emissions over the next 20 to 30 years could actually increase if wood formerly used for product manufacture is displaced by burning. As well as supporting the case for focusing biomass policy towards short rotation biomass types or end of life wastes, this brings into sharper focus the need to look at the carbon storage potential of different raw materials.

One should also question whether the best use is to burn them in the first instance or whether it is better to capitalize on their economic value in product manufacture and their environmental value as a carbon store which, in some product applications, could run into several decades or depending upon species, hundreds of years. There is a significant disconnect between total biological availability and the material which can economically be brought to market. Unlike short rotation ‘farmed’ crops changes to planting can be implemented over a relatively quick period, forestry is a long term activity and the motivations to plant or fell are many and varied and not always directly related to profit, particularly for the private grower. These, as well as factors such as access constraints or soil protection, mean it is highly unlikely that estimations of potential supply will ever be realised. This has particular significance when considering the demand side of the equation.

A widely respected study by John Clegg Consulting published earlier this year, looked at the potential availability and demand for wood fibre (from all sources) in the UK and identified that demand for some wood sources is already outstripping supply. Over the next five to seven years demand could in fact be more than double the potential supply, leading to a requirement to import up to 30 million tonnes of wood fuel. The negative consequence of this scenario is that domestic wood cost will rise to match that of an import cost, which could be two to three times higher than that currently paid by wood processing companies. With some developers of wood-fired electricity projects seeking to source between 10 and 15% domestically, the risk of displacement of supply from other wood-using industries is a distinct possibility.

Source: Reproduced from the Volume 1, Issue 1 of Bioenergy Insight magazine (http://www.bioenergy-news.com/index.php/Content-Item-Details?item_id=9)
Bioenergy and Biofuel from Biowastes and Biomass

Biofuel and bioenergy produced from biowastes and biomass is a clean energy source which can be produced renewably. The 21 chapters of this book provide state-of-the-art reviews, current research, and technology developments with respect to 1st, 2nd, and 3rd generation biofuels and bioenergy. The book focuses on the biological/biochemical pathway, as this option has been reported to be the most cost-effective method for biofuel/bioenergy production. The opening chapter covers the overview of the current status of biofuel and bioenergy production. The rest of the chapters are grouped into seven categories; they cover biomethane production, microbial fuel cells, feedstock production, preprocessing, biomass pretreatment, enzyme hydrolysis, and syngas fermentation. Algal processes for biofuel production, biobutanol production, bioreactor systems, and value-added processing of biofuel residues are included. This book addresses life cycle analyses (LCA) of 1st and 2nd generation biofuels (from corn, soybean, jatropha, and cellulosic biomass) and the emerging applications of nanotechnology in biofuel/bioenergy production. The book is organized in such a way that each preceding chapter builds a foundation for the following one. At the end of each chapter, current research trends and further research needs are outlined. This is one of the first books in this emerging field of biofuel/bioenergy that provides in-depth technical information on the broad topics of biofuel and bioenergy with extensive illustrations, case studies, summary tables, and up-to-date references. This book will be valuable to researchers, instructors, senior undergraduate and graduate students, decision-makers, professionals, and others interested in the field of biofuel/bioenergy.

What to Attend

2011 Biodiesel Conference & Expo
February 6-9, 2011
Phoenix, Arizona

The annual National Biodiesel Conference & Expo gathers biodiesel decision-makers from across the United States and the world to network, connect and learn. This event will explore governmental policy, technical issues, marketing trends and more. The 2011 conference will include an array of networking and social events, along with the popular Expo.

Biomass Trade & Power Americas
February 23-25, 2011
Atlanta

Biomass Trade & Power Americas offers a comprehensive forum for in-depth analysis of DOE’s direction on biomass utilization in energy/utilities sectors, US & European’s utilities’ expectations for biomass-based initiatives, Changes in renewable energy policy & impact on trade, Opportunities in Southeast’s biomass to energy, Identifying gaps between technological & capital investments among many others.

Bio-Energy 2011
June 2011
Mumbai

This conference would attempt to make a comparative study of the techno economic feasibility for production of biodiesel, bioethanol and biomass gasification in India and abroad. It would also highlight barriers and impediments and technology interventions needed for the development of these bio-energy options and suggest policy interventions and supportive action plan for the development and promotion of bio-energy in India.
News Snippets on Biomass Power

In India, the Khadki Cantonment Board (KCB) is planning to set up a biogas plant in Gawliwada. Construction is expected to commence shortly.

When the ₹55 lakh (€91,930) plant becomes operational it will generate 400 kW of electricity a day from a daily supply of 5 tons of organic waste. The electricity will be used to power streetlights and the cantonment hospital.

The plant will treat a variety of organic waste materials, including that from slaughterhouses, vegetables and fruits. Commenting on the new project, Cantonment Executive Engineer, Arun Godbole said: ‘Each day an estimated 300 m³ of gas will be generated at the plant. The gas will be stored in a storage system and supplied to the generator which will run on it. Every hour an estimated 30 kW of electricity will be generated by the generator.’

The Board believes that project will have a payback period of around four years. ‘While the plant will come up at an estimated cost of ₹55 lakh, the anticipated revenue in terms of generation of electricity and bio manure will be ₹14.1 lakh every year,’ Godbole explained.


Haryana Plans Mass Biofuel Production

In a bid to make Haryana eco-friendly, the state government has formulated a plan for mass production of biofuels from all kinds of biomass and organic waste.

“A ₹1.83-crore plant will be set up at Hansi in Hisar district which will produce biogas from animal waste. The plant will produce 1,000 cubic metre biogas and 3.96 ton organic fertiliser daily,” an official of Haryana Renewable Energy Development Agency said. The gas would be purified up to 96% and filled in cylinders and will be sold at the rate of ₹25 per kg.

“One such plant would also be set up at Mohana in Sonipat at a cost of ₹1.45 crore. By converting biomass, animal waste, wastes from hotels, hospitals and industries into biofuels, emission of methane gas into the environment could be prevented,” he said.

The department also plans to set up biogas plants with capacity of 25 cubic metre to 85 cubic metre in other places like Kurukshetra and Rohtak.


Clenergen and Yuken in Gasification Biomass Project

Clenergen Corporation is to join forces with Yuken India Limited to install a 4 MW/h Biomass Power Gasification Plant operating on gas engines at their manufacturing facility in Bangalore, India.

The gasification will provide Yuken a secure and sustainable supply of renewable electricity on site. Yuken India Limited was set up in 1976 under a technical and financial collaboration with Yuken Kogyo Company Limited, Japan, for the manufacturer of oil hydraulic equipment. In the last 29 years, Yuken has achieved one of the fastest growth rates in the Indian oil hydraulics industry.

Clenergen India Private Limited, a wholly owned subsidiary of Clenergen Corporation, shall enter into a minimum 15 years Power Purchase Agreement (PPA) to supply Yuken up to the 2.5MW/h, with the balance of electricity generated being sold to the National Grid System. The 4 MW/h biomass power plants will be installed and operational within 10 months upon signing of the PPA.

Mysore Company Eyes Afghan Green Business

Come January and a Mysore-based bioenergy company is about to sign an agreement with a US firm, which has sub-contracted it the job of improving Afghanistan’s bioenergy supplies. Since the terms of the contract are still being finalized, the name of the Washington DC-based company is being kept a tightly-guarded secret.

Since the job that the Mysore-based firm Lablands Biodiesel expects to perform involves some sensitivity, company executives are wary of sharing details on how much the deal is worth and the number of men it will employ to help Afghanistan attain self-sufficiency in the bioenergy sector. All that sources said is that Lablands Biodiesel will be part of a $13-15 billion “model project” contract that the American firm has bagged in the US government’s larger objective of Afghanistan’s reconstruction.

Lablands Biodiesel will help impart training to Afghan nationals so that they are able to indigenously find solutions to the war-torn country’s energy crisis. The training programme is also expected to generate employment in the country, where the unemployment rate is about 40 percent. While the American firm has about six years’ experience in the field, the Lablands Biodiesel has been operating for about eight years and has an annual turnover of 3-5 crore. Lablands Biodiesel will provide total solution in generation of bio-diesel through Jatropha, a genus of about 175 plants, shrubs and trees, considered to be one of the best candidates for future biodiesel production. “The firm will provide training in the process of planting and hardening besides providing all the necessary equipment for generating bio-diesel,” sources said.

Source: http://www.deccanherald.com/content/122027/mysore-company-eyes-afghan-green.html

Indian Scientists Research Agri-Waste to Biofuels

Scientists from Sri Paramakalyani Centre of Excellence in Environmental Sciences (SPKCEES) have developed a process to produce biofuels from agricultural waste. According to the report, Dr Sathesh Prabhu has demonstrated simple pretreatment methods to break down the complex agricultural wastes to enable the ethanologenic microorganisms to ferment them and produce ethanol. He said about 250 - 270 litres of ethanol can be produced from one ton of agricultural waste such as corn stover, rice straw and sorghum stover.

Dr Sathesh Prabhu has financial backing from the Tamil Nadu State Council for Science and Technology and Jawaharlal Nehru Memorial Fund for the research. Sri Paramakalyani Centre of Excellence in Environmental Sciences is affiliated to Manonmaniam Sundaranar University.


Call for Advertisements

We invite organizations to advertise their profiles and products in the Bioenergy India magazine. Advertisements focusing on the biomass energy sector will be offered a space in the magazine. Special discount is available for insertions in more than two issues. For details, please contact Sasi M at sasi@winrockindia.org

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