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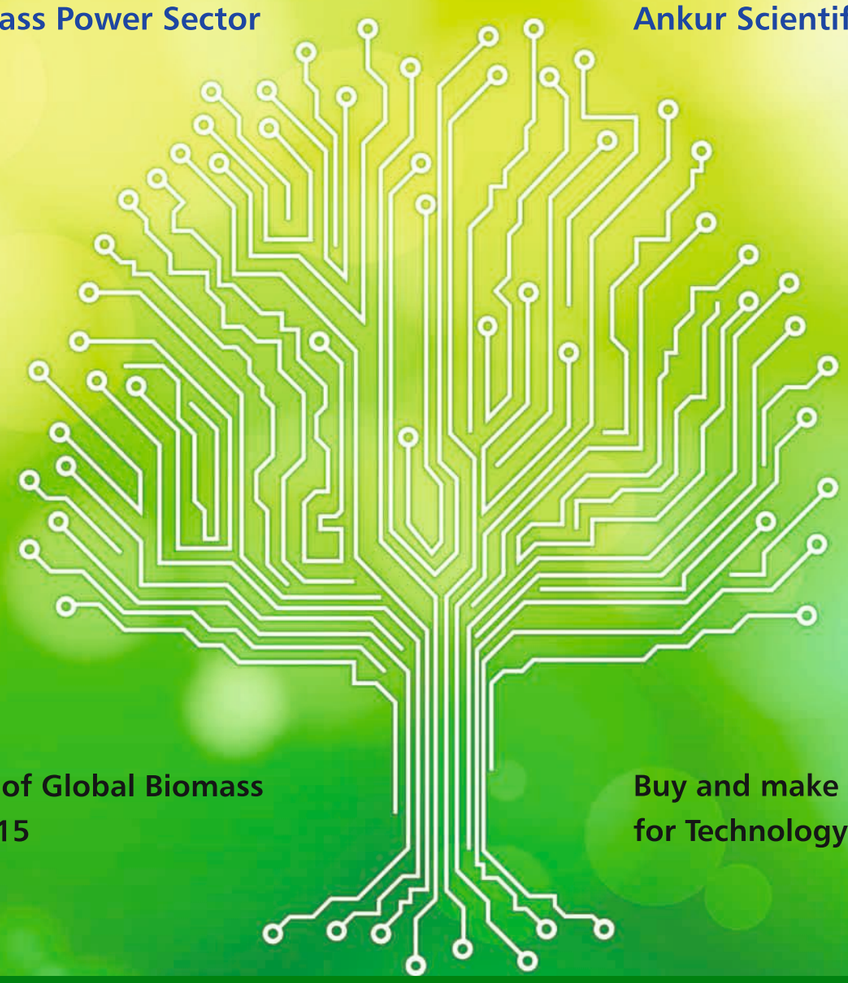
BIOPOWER INDIA

A QUARTERLY MAGAZINE ON BIOMASS ENERGY PUBLISHED UNDER THE MNRE-UNDP I GEF BIOMASS POWER PROJECT

Increased Focus on R&D coupled with Growth of Niche Fuels can Revitalize the Biomass Power Sector

From the Technology Lens: Thermax, Cummins, Ankur Scientific, TERI, IISc



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In this Issue

Technology Innovation and Development

From the Editor

Dear Readers,

Welcome to the Oct-Dec 2015 issue of BioPower India! Our theme for this issue is **"Technology Innovation and Development"**. With new policy actions and financing in place, biomass based power sector in India is looking at a glimpse of revival. While the previous issue focused on imminence of financing needs and challenges in biomass power sector, through this issue we share the latest technological innovations and developments that can further stimulate growth in this sector. Furthermore, we also present the expert views of technological challenges and the need for innovation.

The lead article in this issue provides an overview of the various technological options for generating biomass based power and also discusses the challenges that can be addressed with optimal mix of technology and conducive policy measures.

In our conversation with Prof Rangan Bannerjee of IIT Mumbai he highlights the need for specific technology intervention models for widespread adoption of the technology. In the opinion piece, Mr. Ramesh Chivukula from Areva Renewable Energies India Private Limited, emphasizes the need for R&D to develop cost-effective technological components and/or processes and a niche for fuel utilization technologies that have the potential to tap maximum efficiency and at the same time assuage biomass feedstock concerns.

The spotlight section in this issue showcases the innovation in biomass gasification technology by Indian Institute of Science (IISc), Bangalore and touches upon some of the technical and operational intricacies of the innovative technology.

The issue also features commentary on the potential technology interventions and innovations that can foster growth in the biomass power sector in India from industry experts from leading biomass technology players such as Thermax, Cummins, Ankur Scientific and TERI. We also have the Punjab Renewable Energy Systems Pvt Ltd sharing their perspective on strategy to re-kindle growth in the biomass power sector and Mr. Thirumalai from C-STEP highlighting the opportunities, gaps and outlook for innovation and technology transfer.

It is our constant endeavor at BioPower India to provide a platform for engaging in meaningful dialogue about the goings-on in the biomass sector in India, to facilitate conversations around the same and to showcase efforts made in the field. We do hope you enjoy this issue of BioPower India. Please send your feedback and let us know what other areas you would like us to cover. We look forward to hearing from you at biopowerindia.mnre@gmail.com.

V K Jain

(V K Jain)

LEAD ARTICLE

Technology Enhancement in Gasification Systems key to Reinvigorating the Bio-Power Sector

Amit Parihar,
Engagement Manager, cKinetics

Neel Tamhane,
Associate, cKinetics

Sustainable energy for all and climate change are the two most pressing issues of the 21st century. Today, global energy production & use accounts for two-thirds of global greenhouse gas (GHG) emissions. Therefore, transforming the energy sector becomes essential to address these issues. Renewable energy can potentially play a major role in improving energy access without emission of harmful GHG leading to climate change issue.

Among various renewable energy options, solar and wind energy have drawn considerable attention. However, developing countries with agrarian economies like India also hold substantial promise for energy generation through the biomass route. While solar and wind energy offer the advantage of zero fuel cost; their intermittent availability necessitates the inclusion of storage devices. Biomass on the other hand, due to its local availability and much higher utilization rate is a promising option for electricity generation.

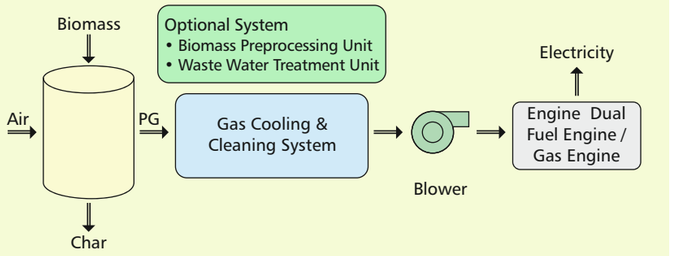
India has set ambitious targets of 175 GW renewable energy capacity addition by 2022 with contribution of 10 GW from biomass based power generation. At present, total installed capacity of biomass based power generation is around 5.3 GW as against the estimated potential of around 18 GW considering agricultural residues. Most of this installed capacity comprises of grid connected biomass combustion and bagasse based cogeneration. Biomass gasification based power generation at sub-megawatt scale may be more appropriate option to harness this huge potential as most of the crop residues are sparsely located and their collection and transportation becomes very difficult owing to their low bulk density.

Power generation using biomass can broadly be achieved through three conversion routes including combustion, gasification and anaerobic digestion. Grid connected biomass combustion is considered more suitable for bigger size plants (megawatt level) due to higher conversion efficiencies. However, availability, collection and transport of the biomass feedstock may pose operational challenges to these large scale plants. On the other hand, biomass gasification route for power generation at sub-megawatts level delivers better efficiencies with lesser challenges related to feed stock collection.

Sub-megawatt scale biomass gasification systems key to harnessing the potential

The power generation from a biomass gasification and engine system is broadly carried out in three stages as depicted in figure 1: (i) conversion of solid biomass fuel into combustible producer gas; (ii) cleaning and cooling of producer gas; and (iii) power generation from producer gas using engine and generator set.

Figure 1: Block diagram of biomass gasification + engine based power generation system



Reactor/ Gasifier, Gas cooling & Cleaning, Start-up Power, Prime mover/IC engine

At each stage, system components may differ in design depending upon the technology supplier but serve the same purpose. For example, closed top and open top are the two major designs of downdraft gasifiers being used for power generation applications. Similarly, different combinations of gas cooling and cleaning systems are employed to achieve clean gas of desired quality at engine entry point. Different reactor designs and inclusion of different set of gas cooling and cleaning systems forms the basis of difference in the technology packages supplied by different manufacturers in the country. Some of the leading organizations actively involved in technology development of biomass gasification based power generation include Ankur Scientific Energy Technologies, The Energy & Resource Institute (TERI), Husk Power systems, Sardar Patel Renewable Energy Research Institute (SPRERI), Indian Institute of Technology, Bombay and Indian Institute of science (IISc).

One of the key parameters for biomass to power conversion through gasification route is biomass quality in terms of its size and moisture content. Therefore based on the specific requirements, biomass pre-processing unit in the form of cutter and dryer may be incorporated in the system line. In gas cooling and cleaning block, water is mostly used to cool as well as clean the gas which results into generation of waste water requiring need of waste water treatment unit. Further, in case of non-availability of grid power, diesel generator or battery based systems may also be required to initially start the system operation.

Despite potential, challenges have plagued the scale-up of gasification segment

Despite its long time existence and distinct advantages, biomass gasification route has been able to demonstrate limited success as against the combustion route. This can be attributed to mix of technical as well as non-technical barriers including biomass availability, higher operation & maintenance issues, requirement of trained manpower, low plant load factor (PLF) etc.

On technology front, the major challenges have been primarily around gas cleaning & cooling system followed by reactor to some extent. Challenges on the reactor side mainly pertain to ability of the reactor to handle different kind of biomass feedstock and generation of good quality producer gas with minimum tar and dust content. The challenges on engine side initially included availability of dedicated producer gas engines however this has been adequately addressed with major engine suppliers now providing dedicated gas engines for power applications.

Technological enhancements provide an impetus

There have been continuous efforts made by several organizations to address various challenges typically encountered across different elements of biomass gasification based systems. In case of the reactor design, development of open top reactor technology has helped in generation of producer gas with low tar content. In this arrangement, air required for gasification process is provided both from top as well as sides of the reactor. This dual air entry helps in reduction of tar content in the raw producer gas mainly due to cracking of tar in relatively high temperature environment inside the reactor.

In order to reduce the tar content in the producer gas, concept of two stage biomass gasifier system has also been developed and is being tested extensively. This design incorporates separate reactors for pyrolysis and gasification with a high temperature tar cracking zone in between. This advancement is seen to generate producer gas of high quality and low tar content resulting in improvement of overall efficiency and zero waste water generation.

In addition, technological development carried out on the gasifier side has increasingly enhanced the ability to generate power from different kind of feedstock available across different geographies of the country.

The key focus of research and development on the gas cooling and cleaning side has been on development of dry gas cooling and cleaning system with the aim of bringing down the particulate matter and tar concentration within the permissible limit and ensure trouble free operation of the engine. Typically this is being managed through inclusion of chilled scrubbers in the gas cooling and cleaning system – however while these help in removal of very fine particulates from the producer gas, there is also an increase in the internal power consumption of the system. Recent advancements have entailed use of wet electrostatic precipitator (ESP) technology for gas cleaning. Development of dry gas cooling and cleaning system through inclusion of hot gas filtration systems is expected to yield a major breakthrough as it eliminates the need for water as well as waste water treatment units.

Figure 2: Technological enhancements in biomass gasification based power generation systems

Equipment	Challenges	Technological advancement
Reactor	• Ability to produce gas with minimal tar content • Reactor development to handle different biomass feed stocks	• Development of open top down draft gasifier design • Development of two stage gasification system
Gas Cooling & Cleaning System	• Ability to cool and clean the gas to the required to the required limit • Reduce water consumption and waste water generation • Reduce internal power consumption of the system	• Development of gas cooling & clean system incorporating scrubbers, filters and chilled scrubbers • Development of wet ESP technology • Development of dry gas cleaning technologies

The prime mover block of gasification system has had relatively lesser challenges. Most of the earlier installations were based on dual fuel technology. Availability of dedicated gas engines of lower capacities was one of the challenges leading to locally available diesel engines being converted to ensure producer gas based operations. Thus, with the availability of dedicated gas engines, dual fuel operation has been almost completely eliminated.

Looking Ahead

Considering the current installations of biomass based power generation vis-à-vis identified potential, biomass based power generation systems at sub-megawatt level through gasification route hold potential to supply electricity especially in rural areas using locally available biomass. Research and development activities undertaken by various organizations have helped in overcoming different challenges historically acting as constraints in the sector. With these recent technological developments along with favourable policy environment, technology can make significant contribution to target of achieving 'power for all' and 'energy self-sufficiency' in the country.

Amit Kumar Singh Parihar is member of energy advisory group at cKinetics consulting. He has 8+ years of experience in energy and environment sector with core expertise in renewable energy, distributed power generation system, Energy management and sustainability. He is a mechanical engineer by training and has done M. Tech in Environmental science and engineering from CESE, IIT Bombay.

Neel is a young renewable energy professional with a focus decentralized renewable energy and rural electrification projects. He has pursued B.Tech - Solar and Alternative Energy from AIRAE (Amity Institute of Renewable and Alternative Energy)

EXPERT SPEAK

"Biomass Technology needs to be Marketed as an Appealing Package"

BioPower spoke to **Dr. Rangan Bannerjee**, Head of the Department, Department of Energy Science and Engineering, IIT Bombay on the potential technology interventions and innovations that can foster growth in the biomass power sector in India

The 10 GW target for bio-power is achievable provided a few pre-requisites are looked into.

How was the biomass power sector progressed in India as per you? Do you feel that the target of 10 GW set by the government is achievable?

The biomass power sector has been relatively fragmented compared to other renewables. Fundamentally there are a large number of small players that have been driving the sector. However, there are only a handful of developers that have scaled up.

In comparison to other renewables such as solar and wind, the biomass power sector has seen lesser attention. This has been primarily due to some major areas for concerns such as assuring a sustainable biofuel supply linkage.

The 10 GW target for bio-power is achievable provided a few pre-requisites are looked into. Focus is required on enabling the small companies with technology backup, finance and standardization in order to scale up.

What were the main bottlenecks in the available technologies?

Biomass gasification, biogas, biomass power based on the Rankine cycle are the prevalent technologies currently being used in India.

There is a fair understanding of know-how in the biomass gasifier sector. From a technology perspective the major challenges lie in the cooling and cleaning techniques being deployed. Collection and removal of dust and tar are primary areas of concern.

Reactor design and the engine also have had pertinent challenges. However, the challenges in this area have been better addressed with the help of collaborative efforts from academic institutions and the manufacturers.

In the case of Rankine cycle based power plants, the boilers are easily available for such plants but there are very few turbine manufacturers in the small scale segment. It's like a chicken and egg problem; the market hasn't grown as expected. Certain government based interventions can help bridge the gap and provide assurance the manufacturers to invest and venture into the market.

The biomass power sector needs a thorough understanding of the technology and O&M requirement of the system, unlike solar PV the user needs to have some level of skill and expertise. Standardization of training in O&M of the biomass power plant is essential to ensure the smooth functioning of the plants.

There have been considerable number of installations of biomass power plants but the issue of sustaining continuous feedstock supply for the power plant is a more important issue, especially with large scale plants. Also, transportation and collection is a challenge and sourcing the feedstock locally isn't easy either. Biomass power plants have been doing well in regions where there is availability of industry based biomass waste.

What are the present techniques being used to deal with dust and tar?

Gas cleaning and cooling have been primary areas of concern in terms of technology. A good gas cleaning system is required to deal with the particulates and tar. The treatment and cooling has a substantial cost which is why developers have not been inclined to adopt the existing solutions. However, increased tar content in the producer gas results in frequent choking of the engines thus resulting in loss of operating time with additional efforts required to manually clean the engine.

Additionally, the system also requires periodic scheduled shutdowns which can be for over a month in a year which is required for maintenance. It is possible to meet the Central Pollution Control Board (CPCB) norms but the gasifiers are usually small in size and the issue of quality control, standardization and testing are prevalent and need to be paid attention to. Academicians across various institutes in India have been conducting some research on tar/emission/particulate matter control from gasifiers.

Feedstock used in India is different compared to that used globally. Considering this, how do you feel existing technologies compare with the best global technologies in the market? How does a multi-fuel system compare against a single fuel system?

A lot of the biomass feedstock is not monetized, most of it is used in cooking in rural households, some of it is channelized through market mechanisms and some of it is directly collected from the source.

The moment a biofuel market is created, it may have an implication on the rural community in terms of availability of biomass cooking fuel. Also, once a power plant is put up and people realize that the plant is dependent on their biomass waste, the cost of the biomass tends to go up significantly. An agreement with the co-operatives is required to establish a sustainable biomass feedstock supply linkage with periodically regulated prices for the biomass. Ergo, the focus needs to be on large concentrated biomass wastes available from industries. In such cases a plant can be established with assured supply.

In terms of technology for gasification, India has been primarily focused on atmospheric gasification whereas the international experience has been more on pressurized gasification. Some companies in India have done well and have also been able to export their products to Brazil, Sri Lanka and several other countries. However, India hasn't been able to create an environment to scale such initiatives. Besides that there are prevalent challenges in terms of tar removal, reliability, standardization too. The technical know-how has reached a certain level but capitalizing and scaling up the industry has been a challenge.

The technical know-how has reached a certain level but capitalizing and scaling up the industry has been a challenge.

Do you see any scope/requirement for technology transfer as well as technology innovation in the biomass power sector in India?

Internationally too the biomass based power sector hasn't been much vibrant. The focus has been on large scale bio-power systems only. Also, the biomass power sector internationally has been particularly driven by wood based biomass fuel.

As far as technology transfer is considered, adoption of an entire package for technology transfer may not be a good option. However, adopting a few specific individual components/techniques from the west such as technology for control, reducing tar, gas cleaning or even better technology for turbines might be worth considering.

Also, innovations in the following areas need to be emphasized on:

- Packaging the technologies as easy to use products to enhance marketability
- Easy O&M to make the plant more user friendly
- Incorporating monitoring and control mechanisms in the systems
- Customizing the technology according to its intended end use application

Additionally, new segments can be explored, such as powering telecom towers in remote areas and biomass gasification for cooking purpose. Moreover, students need to be engaged at an early stage for research and to initiate new start-ups in the sector. With guidance from organizations such as the National Innovation Foundation, new innovative technologies can be recognized and can be taken forward to make refined marketable products of it.

Could you further elucidate the areas of intervention to enable widespread adoption of the biomass power technology?

The sector had initially seen success through many Rankine cycle based power projects installed in Andhra Pradesh about a decade ago. They were working fine because of the subsidies and

incentives provided by the government, however when biomass wasn't available it was often being substituted with coal. In the case of grid connected biomass power systems, there are very few systems functioning on the biomass gasification technology. Small and medium sized companies such as Ankur Scientific Energy Technologies Pvt. Ltd, Cosmo Powertech Pvt. Ltd, Netpro Renewable Energy (India) Pvt. Ltd. are a few prominent players in the domain.

Biomass technology needs to be marketed as an appealing package which comprises of a system that has ease of maintenance which is critical in order to attract adoption of the biomass power technology. Also, standardization of the systems is essential. Improved design coupled with effective control and O&M packages are required to be packaged into marketable products. Unless the systems are dependent on industrial waste for industrial application the potential market lies in the domain of rural electrification which is dependent on intervention and subsidies.

A comparative study of bio-power with solar PV and grid based power needs to be undertaken to gauge its potential use in base load type of applications in combination with other renewables. A biomass based system not only helps in energy generation, it also generates local employment and most of the cash flows back in to the local economy. Other than that, when solar reaches beyond 15-20% penetration levels energy storage will have to become the focus to compensate for the intermittency. We also need to have technologies that can be conveniently dispatched. Even if more focus is put in solar, biomass power will have to play a substantial role in compliment it. A strategy and plan needs to be struc-tured dedicatedly for biomass power.

What is the potential application of gasification for high capacity systems? (6 MW<)

Biomass technology needs to be marketed as an appealing package which comprises of a system that has ease of maintenance which is critical in order to attract adoption of the technology

Biomass integrated-gasifier/gas turbine combined cycle technology can be used for larger systems. Diesel engines are available in the megawatt (MW) range so, that is not a matter of concern. However, the fuel supply linkage is certainly a considerable challenge. The route of biomass plantations for ensuring consistent fuel supply may have to be considered. One of the key issues that emerged globally was whether the land on which the plant is set up is cultivable and whether agriculture will be deprived of the land for the purpose of serving energy.

What kind of policy incentives could help increase uptake?

A strong technology support organization needs to be established to create a supportive platform. Like solar has a dedicated national solar mission and various other schemes, such schemes for bio-power are also required to accelerate the development.

Maybe an organization like a National Bio-power Corporation (like the NTPC) can be set up to revive sub-optimally performing units as well as create a supportive platform which can help develop more effective organizations in the domain. There is also some scope for establishing training and development centres.

More incentives are required for increasing demonstrations and presentations for existing technologies to enable enhanced adoption. Existing manufacturers need to be approached and activity in the sector needs to be encouraged through incentives such as grants, subsidies, supportive policies and preferential tariffs.

Moreover, there is also a need for standardization, probably a few large companies such as BHEL, NTPC (companies with experience in the power sector) could consider entering the bio-power domain, similar to how NTPC has entered the solar domain. It can act as a joint sector company which provides the technology, know-how, maintenance and support to different franchisees and companies in the sector. However, all this can only happen when they see a very strong business potential in the domain.

Could you share your outlook for the sector (specifically from technology stand point)?

Bio-power certainly has substantial potential to grow but the need hasn't been translated in to a visible demand. Government initiatives, policies and schemes are critical for the sector to develop. Large and medium scale industries need to be involved and need to take on the challenge and scale up. Moreover, collaborative efforts between the government and the industries are required to create a healthy research environment to build new indigenous technologies. In the next decade or so, the sector stands to play a major role in meeting our sustainable energy and energy access goals.

Prof. Banerjee is the Forbes Marshall Chair Professor in the Department of Energy Science and Engineering at IIT Bombay. He was responsible for creating a new Department of Energy Science and Engineering in 2007 and was appointed as its first Head. He has also been the Associate Dean (R&D) and later Dean (R&D) at the Institute. His areas of interest are energy systems engineering, energy efficiency, energy planning and policy.

SPOTLIGHT

Biomass Gasification, an Option worth Considering to meet India's growing Power Demand

Dr. S. Dasappa, Associate Professor, Centre for Sustainable Technologies/ ABETS, CGPL Indian Institute of Science

The biomass gasification technology has been in existence since the World War II (Closed top design). Some of the most insightful studies on wood gasifiers took place in this period. Subsequently, most of the countries started re-visiting the technology primarily after the 1970's oil crisis. In early and mid-eighties several institutions started looking at the technological intervention in the sector. The limitation with the technology was that it accepted charcoal as a fuel, which means that the wood was converted to charcoal and then was utilized in a gasifier. Issues with using wood as a fuel were that it resulted in substantial tar formation which would choke the engine and the engines couldn't work for long durations at a time. At that point in time gas generation was not an issue but utilizing it in an engine was.

In India about half a dozen educational institutions like IIT and IISc plunged into development of such technologies in the early eighties. The focus was primarily around understanding why tar was such a big pain point and what mitigation techniques could be adopted to deal with it. Another area of focus was looking for an alternative biomass feedstock such as agro based residues. Most of the groups across the globe had been only looking at wood as the basic fuel. Nonetheless, India being an agrarian economy more attention was diverted to agro based residues.

IISc thus has been primarily focused on reducing the amount of waste such as tar being generated. The whole process needed a slightly different approach as the vicious cycle of generating tar and then eliminating it was becoming a costly affair and also leading to environmental pollution. Thus, efforts were primarily directed to reduce the generation of tar in the first place. Today we are capable of generating a gaseous species that have very little contaminants which don't hamper the engine operation. Additionally, multi-feed gasification was also addressed to cater to seasonally available biomass fuels (Using multiple fuels require pre-processing such as cutting the feedstock to appropriate particle size, drying etc. Fuels with lower density are made to go through a process of homogenization in the form of briquettes).

Issue with rice husk is that it generates high ash content (ash content - 20% by weight). Residual disposal of tar is an environmental issue and is also a concern due to engine choking.

Large scale wood based Rankine cycle systems driving the International market

Internationally, biomass gasification has been more feasible because of the appropriately regulated feed in tariffs. In Japan, setting up a grid connected gasification system below 1 MW is compensated with € 40 cents/ kWh of tariff to feed into the grid and in Europe the plants receive € 28 cents/kWh. Where as in India, the feed in tariff rates are at € 11 cents/ kWh (considering € 1 = INR 70) at best.

Most international projects, especially ones based on European technologies are dependent on wood as a fuel. **In India a lot of groups focus on rice husk as a fuel but the issue with rice husk is that it generates high ash content (ash content - 20% by weight).** Overall the residual disposal of tar is an environmental issue and is also a concern due to engine choking. Several gasifier users have claimed that engine choking has been reported in less than 20 hours of operation too.

IISC's novel open top re-burn down draft gasifier

Among the biomass gasification technologies in the world, the open top, twin air entry, re-burn gasifier developed at Combustion, Gasification and Propulsion Laboratory (CGPL) of Indian Institute of Science (IISc) is unique in terms of generating superior quality producer gas. Currently there are more than 40 plants operating based on this technology worldwide for both heating and power generation applications. The USP of this system is that it is designed to offer longer residence time of the reacting mixture in the reactor which results in considerably lower tar content even at different throughputs during syngas production.

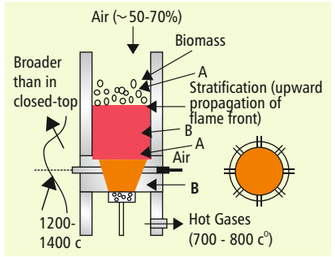
The USP of this system is that it is designed to offer longer residence time of the reacting mixture in the reactor which results in considerably lower tar content even at different through puts during syngas production.

Broadly there were three key areas which required improvement in the existing biomass gasification technologies, namely the reactor, the cooling and cleaning techniques and the engine. All these areas have been worked upon by IISc in its recent technological innovation.

Broad high temperature zone critical to the reactor

The unique, novel open top down draft gasifier is designed with a ceramic-lined cylindrical reactor to stand high temperature and meet industrial standards. The open top operation leads to bed stratification, wherein stable layers of pre-heating, volatile matter combustion and reduction zones are formed and there is little opportunity for any gas to leak past any of the zones.

The system is designed such that it has a dual air entry system wherein air is drawn from the top and from the air nozzles at the bottom which permits establishment of a uniform front moving propagation towards the top of the reactor. This favours a high residence time for the gases at elevated temperatures thereby eliminating the tar.



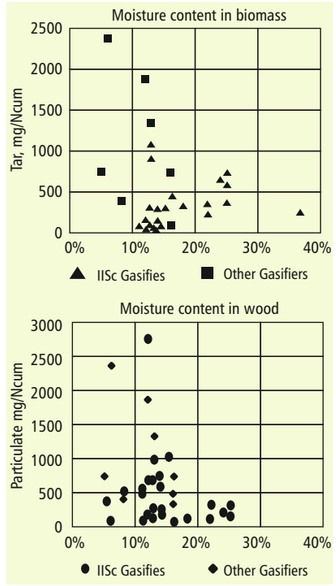
The key advantages of the system are

- The system's ability to crack the tar in the high temperature oxidative atmosphere in the reactor itself improves the gasification efficiency
- Availability of a broader high temperature zone which also ensures gasification efficiency of more than 80%
- Ability to accept multiple fuels without compromising on plant performance as such. The plant can accept forest & plantation residue, agro residue, RDF in briquetted form with a maximum moisture content of 15%
- It is an environmentally sound system as it has low NOx in the engine exhaust and the plant also includes an effluent treatment plant resulting in further reduction of pollution.
- Superior gas quality, suitable for turbocharged engines

The advantage of superior reactor design is related to the energy available in the gas. Tests and measurements show that cold gas efficiencies have been in the range of 75% even at fuel capacities in the range of 75 kg/hr. These results reflect some of the best conversion efficiencies even when compared to literature available on other gasifiers. Furthermore, large scale gasifiers with fuel consumption capacities of 650 kg/hr, have resulted in cold conversion efficiencies in the range of 85%.

A series of comparative tests were conducted both in India and Switzerland which even included biomass with 37% moisture content. The production of tar and particulate matter in the raw gas with different fuels (of varying moisture content) for different gasifiers was studied in depth and compared to that of the IISc design.

The measurements for the gas quality by established procedure reflected tar and particulate levels in the raw gas obtained were less than 50–250 mg/Nm3 with IISc gasifier as compared to 1 g/Nm3 generally found in other down draft gasifiers. Tests conducted on the particle size in the gas at the cyclone exit indicate that a majority of the particles (> 95%) were well below 0.5 mm in the IISc gasifier.



The reduction in tar content is primarily dependent on the thermochemical aspects of the reactor design. The amount of tar content in the producer gas is dependent on the air flow, temperature profile in the reactor and the heat loss from the reactor.

Customized engine for biomass gasification for optimum efficiency

IISc worked with Cummins India Ltd (CIL) on designing engines specifically for biomass gasification that could efficiently process the syngas. We also developed patented producer gas carburetion system which ensures nearly constant air-to-fuel ratio for handling varying loads. as the natural gas engine was being transformed into a producer gas engine specifically introducing a carburetion system was necessary as the air-to-fuel of natural gas is about 17:1 (mass basis),whereas for producer gas it is about 1.3:1.

Industry standard water cleaning system

The open top down draft gasifier system also has a unique screw based ash extraction system which allows for extraction of residue at a predetermined rate. The system has incorporated the Cn patented technology for gas cooling and cleaning. This process involves using hot high efficiency cyclonic separation for the removal of dry particulates from the gas and ejector scrubbers to cool and clean the gas. The gas is then further dehumidified, to reduce moisture content and fine contaminants.

During this process the water used for cooling and cleaning gets contaminated with both dust and some organic compounds like phenols, aldehydes, etc. Therefore IISc has added an auxiliary water treatment plant which is in line with the requirements of industry and pollution control board. Conventionally, the water being used in gas cooling and cleaning was recirculated without any treatment, resulting in excessive contamination of the water which also affected the quality of gas. Thus, the introduction of the water treatment system is not only beneficial to the environment but it also ensures better performance of the gasification system.

International interest and uptake for the technology

The rigorous testing and R&D demonstrated that the IISc open-top gasifier provides a high efficiency technology, with the ability to accept a variety of agro residue briquettes without any modification. The superior quality of the gasification technology has even been taken up by multinational corporations such as General Electric who have scouted across the globe to find a suitable technology before narrowing down on IISc's proprietary technology. The technology transfer from South to North is one of a kind and is going to be utilized by Phoenix Energy to set up power plants in California.

Performance based incentives are a good way to incentivize better uptake and performance of the bio-power plants.

Policy support required to act as pivotal driver

For the technology to be successful it needs to be economically viable and scalable. Creating level playing field is essential for the biomass sector to see more interest and investment.

Many times the state distribution utilities tend to buy power from the national grid when there is a power deficiency. They are forced to purchase the power even at tariffs as high as INR 9-15/unit during emergencies. There is a need for a policy which will enable the commissions to buy the power on a regular basis from biomass based gasification plants.

Performance based incentives are a good way to incentivize better uptake and performance of the biomass power plants. Introduction of innovative schemes like the generation based incentives (GBI) in the wind energy sector helped propel the sector into increased activity. If similar incentives are provided to the biomass power sector the developers will be inclined to improve their performance too.

Dr. Dasappa obtained Masters and Ph. D degree in the faculty of engineering from the Indian Institute of science. He has worked in the area of combustion and gasification of biomass. The work has resulted in the understanding of various processes occurring during gasification and answered several myths in the area of gasification. Based on his analytical and problem solving skills he contributed to the technology packaging for various capacities. Based on his team-oriented approach with an impressive record of start-up and turnaround situations, he has been able to take initiative and responsibility to develop new engineering solutions.

INDUSTRY SPEAK

Increased focus on R&D coupled with Growth of Niche Fuels can Revitalize the Biomass Power Sector

Ramesh Chivukula, Technical Director of AREVA Renewable Energies India Pvt. Ltd.

Biomass fuels are complex in nature and from a technical stand point the feedstock being used in biomass power plants needs to have certain characteristics for optimum utilization.

India has a potential to generate 18 GW from bio-power. The sector has seen chequered growth due to multiple factors including increased cost of feedstock, unattractive feed-in tariffs, low plant performance, etc. Biomass power is capital intensive and can cost up to INR 50 – 60 crores for a 10 MW plant. Unlike other renewable energy sources such as wind and solar PV, biomass power has substantial operational expenses too. In order to keep these O&M costs under check, technology and feedstock are two key components to be worked upon. A more robust and sustainable ecosystem can be made by selectively tackling each challenge. For the biomass power sector to flourish, a varied combination of different technologies needs to be implemented. Depending on the environment, availability of resources and other local factors, different techno commercial solutions may need to be adopted. These technologies don't have to compete with each other instead they can be implanted such that they complement each other.

From a technology perspective, special attention needs to be given to the preparation and fuel feeding systems as the moisture content, bulk density and particle size are critical factors that affects the technology performance. Depending on the fuel chemistry an appropriate firing technique needs to be selected too. Even with established technologies proper operation and maintenance is crucial to the plant performance. Trained labour needs to be hired to operate and maintain the plant.

Fuel size, chlorine and alkali content are critical factors to be considered in the design of boilers

Biomass fuels are complex in nature and from a technical stand point the feedstock being used in biomass power plants needs to have certain characteristics for optimum utilization. The following biomass fuel characteristics are vital in designing boilers:

Chlorine content

The presence of Chlorine leads to accelerated corrosion especially in super-heater area. Moreover, Chlorine corrosion is further increased in the presence of Sulphur dioxide (So2). The extent of Chlorine corrosion depends on boiler temperature, concentration of Chlorine, presence of Sulphur and Alkali metals in the agriculture residue.

Alkali content

High alkali & alkaline earth metals in the ash of biomass fuels creates serious fouling[1] and slagging[2] in conven-tional boilers. Even with the combined use of sorbents[3] with additives the biomass power plants can utilize these fuels only to a certain extent. Deposit formation due to alkaline content results in reduction in heat transfer rates, fouling and accelerated rate of fire side corrosion.

To tackle this challenge, usually biomass fuels (such as crop residue) are blended with fuels with lower alkaline content such as wood to reduce fouling and slagging.

Key factors that contribute to the extent of slagging and fouling which can take place are

- Mineral characteristics of fuel (Chemical composition of the fuel)
- Fuel chemistry (Composition and structure of solid fuels determining combustion reactions)
- Combustion chemistry (Mechanisms of the thermo-chemical conversion process based on stoichiometry)
- Particle transport (Movement of alkaline particles in the boiler and the probability for particles to get stuck on the heat transfer tubes)
- Fluid dynamics (Understanding of solid circulation in the boiler)
- Condensation (Accumulation of tar and organic compounds on cooling)

Effects of fuel type, size and volumetric flow

Most plants have to use multiple fuels (non-homogenous) through the year due to seasonal availability of feedstock. Using multiple fuels with different properties implies that each fuel will have different calorific values, bulk density, size and different composition. Therefore, using multiple fuels can result in uneven combustion of the fuels and varying plant performance. Typically there are 3 crop cycles in India and different crops are grown in different seasons in most regions. Thus continuous availability of homogenous fuels is unlikely.

Unlike other fossil fuels, biomass feedstock has comparatively low bulk density. Fuels with high bulk density are advantageous because they represent a high energy-for-volume ratio. Low bulk density fuels sometimes give rise to insufficient flow under gravity resulting in low gas heating values and ultimately in burning of the char in the reduction zone. Also, this necessitates the need of handling large quantities of fuel for firing in the boiler to generate power. Moreover, high moisture content reduces the thermal efficiency since heat is used to drive off the water and reduces available heating value and inhibits proper combustion.

Transfer and adoption of the latest technology like the **hydro-thermal carbonization** from the western nations along with setting up local manufacturing units to produce similar systems is a way to improve the plant performance.

Hydrothermal carbonization (HTC) of biomass is a thermo-chemical process for the conversion of solid biomass matter at elevated temperature and pressure in the presence of water. The resulting product is a biomass-water-slurry, where the biomass fraction can easily be separated and significantly differs from the starting material in its chemical and physical properties.

During the HTC reaction, water, carbon dioxide and other compounds are split from the biomass. Thereby the energy density is raised significantly and the heating value is approximate to that of dry, high quality brown coal.

Given that hydrothermal carbonization takes place in an aqueous reaction medium, it allows utilizing preferably wet biomass as raw material. Such wet biomass materials are currently not or almost never used, which reduces the competition on utilization to minimal

This HTC technology is very proven and mature in Europe but has become too expensive to manufacture there. With transfer of technology to India under "Make in India" program; this could provide a complimentary technology and economically feasible option.

Additionally, more resources should be allocated by Indian corporates in R&D to develop indigenous technologies.

When it comes to comparing technologies used abroad with respect to India, India fairs well. Indian boiler designs are almost comparable to western standards. It is only in execution that we lag behind. Adoption of European technology with domestically produced systems can further improve the standards of technology being used in India. Forbes-Vyncke boiler is one such example of a fine blend of latest superior combustion system design, manufactured at lower costs in India, with quality systems matching global standards. Vyncke boiler uses very sophisticated and robust step grate technology that provides a great solution for mass combustion of very complex biomass and municipal solid waste. Again this grate when manufactured in Europe is far too expensive but when made in India; as in the case of a world class manufacturing facility of Forbes Vyncke in Pune, becomes a very viable solution.

[1]Fouling: It is defined as the formation of deposit on convection heat surfaces such as superheater and reheaters. It takes place as flue gas & suspended fly ash cool down.
[2]Slagging: It is the formation of molten or partially fused deposits on furnace walls or convection surfaces when directly exposed to flame radiation.
[3]Sorbent: It is a material that has the capacity or tendency to either absorb or adsorb liquids or gasses. (Flue gas in the gas of biomass boilers)

AREVA has been working with a European boiler supplier, namely Leroux & Lotz Technologies (LLT) (Altawest group) for superior solutions for extremely complex biomass and MSW. LLT has 45 years of experience in this field and are also operating currently four such plants engineered and built by them. LLT uses a world reputed design of Hitachi- Zosen Step- Grate (half the population of waste to energy combustion plants use this technology). The specific rugged design is meant for mass combustion of MSW and RDF.

Cultivation of new niche fuels may help assuage biomass feedstock concerns

Establishing an uninterrupted supply of biomass feedstock is essential for the biomass plant and has emerged as one of the major challenges in the past decade. Unlike coal power plants which have a centralized body responsible for the mining and distribution of the fuel, biomass power plants have to set up their own supply chain. Predominantly fuels like rice husk, bagasse and wood chips are utilized in biomass power plants. However, with increase in fuel costs (the average cost of agricultural residue in India has increased from INR 800/ Ton in 2006-2007 to INR 3300/Ton in 2014) and increasing demand for these fuels by other industries there is a need to find alternatives. AREVA is looking at focusing on niche fuels with cultivation of energy crops such as King Grass / Napier grass to partially support the feedstock supply chain even if the entire dependency from existing fuels is not shifted. These biomass fuels are have been used successfully in South East Asia & in Latin America. Costs of these niche new biomass fuels comparatively lower than the regular feedstock. An added advantage of energy crop plantations is a stable fuel price, thus making biomass power more economically viable. Government could consider using arid lands for the cultivation of such crops which can then be supplied to the biomass power plants. Task force committees are being set up to explore new cleaner and biomass fuel that can be quickly replenished. Also, IISc had created a database for biomass availability across various regions in the country which could be modified into a regularly updated portal with instant updates.

Considering India's growing energy demand, wind and solar PV aren't the only resources that can help sustainably cater to the power demand. Biomass power will be required to compliment it and depending on the environment, availability of resources and other local factors, different techno commercial solutions may need to be adopted. From a technological stand point, focus on increased investments in R&D coupled with technology transfer is vital to sustain and improve the sector.

Mr. Chivukula Ramesh completed his Mechanical engineering graduate degree from NIT, Trichy in 1982. He has more than three decades of extensive experience in the design and engineering of complete thermal and gas turbine based power plants. He has been with AREVA Renewable Energies India ltd since Nov 2007 as Director – Technical and is responsible for management of proposals and detailed engineering for renewable energy based power plants, including biomass and waste to energy. He has also been nominated to AREVA college of Experts as AREVA Senior Expert (Level 2).

From the Technology Lens

BioPower India spoke to the key technology companies (Thermax, Cummins, Ankur Scientific and TERI) on the current status and their outlook for technology innovation in the gasification segment in India.

Progress of the biomass power sector in India and outlook for meeting the 10 GW target

Thermax, Dr. Sonde

On the whole, the progress for the biomass sector has been in patches, with impressive progress in segments like bagasse based cogeneration or rice husk powered power plants but it has been generally lagging in other biomass segments particularly, biomass generated from agro residue other than bagasse and husk, trash from agricultural processing, rice straw etc.

It is possible achieve the target of 10 GW set by the government if concerted efforts are taken for developing appropriate technologies for entire spectrum of biomass.

Ankur Scientific, Mr. Ashok Chaudhuri

Growth in the biomass power sector has been slow and there has been limited activity in the domain for a couple of years. Nevertheless, the government has extended support to accelerate the growth of the sector. Recent effort such as the tariff guidelines from CERC has been one of the major developments in this sector but its implementation and uptake by the states will be key. Ministry of New & Renewable Energy has initiated various schemes to support the domain but other issues have hindered the growth.

The 10 GW target is indeed very ambitious. To be able to achieve the target, a strategic road map needs to be created followed by a substantial increase in the installation of biomass power projects on year on year basis.

To provide an impetus some of the following pathways are essential, and the existing ones to be strengthened further:

- Setting up of centre-states co-ordination committee which can push for fast approvals
- Favourable policies like higher tariffs for power sale, generation based incentives (GBI),
- Single window clearance for new projects
- Strict adherence to renewable portfolio obligations by industries and states
- Discouraging use of fossil fuel based energy generation in industries
- Availability of long-term low-interest rate based loans to enhance uptake of projects
- Specific policy for less than 2-MW biomass based power plants for promoting sustainable economic development and environmental protection

TERI, Mr.Sunil Dhingra

A number of programmes have been initiated for promotion of biomass based electricity generation. The key challenge faced by the industry is due to the market for biomass resources being highly un-organized, dispersed and scattered in nature. Competing uses of biomass resources and high cost involved in collection, storage and transportation makes the input resource expensive which result in biomass power unviable at current electricity tariff offered by most of the States. The target of 10 GW power production from biomass seems fair and seems likely to be achieved in the coming years with the right of policy packages being implemented.

Cummins, Mr. Balaji

Of the present installed biomass power capacity, a substantial portion is comprised of Rankine cycle based systems and bagasse based systems with gasification only contributing about 2-3% of the share. Considering that in the past 20 years 4.5 GW of plants have been set up, achieving 10 GW by 2022 is an optimistic target. However, with the intent and progress shown by the government it seems to be achievable.

Innovative biomass gasification technologies currently being deployed

Thermax, Dr. Sonde

Thermax has been one of the notable companies in the thermal power sector and has also worked on various innovative technologies and projects such as:

- Design and development of different types of combustion systems like the reciprocating pulsating grates for briquettes / pellets
- Technologies for gas clean-up both using bag filter and ESPs
- Up draft moving bed gasifiers for small sized power plants
- Versatile gasification technologies for handling various types of agro residues
- Water independent tar removal systems

Ankur Scientific, Mr. Ashok Chaudhuri

Ankur Scientific has designed different types of gasifier systems which are customized to handle different types of biomass and wastes. More than 50 different types of biomass feedstock have been used in their gasifiers till date. Moreover we have designed a state-of-the-art dry gas cleaning technology for cooling and cleaning the producer gas from the gasifier before it is fed into the engines for generation of power or for a host of thermal / process heat applications. Thus, unlike the conventional technology of wet gas cleaning, there is no process water generated and thus there is no hassle of handling and treating the process water or disposal of sludge etc. The overall operations are therefore very simple, neat and clean, environment friendly and requiring lesser manpower.

Generally in woody biomass based gasifiers, the charcoal / char output was limited to 6 to 8% of the feed. However, now Ankur Scientific offers a pyro gasifier which is a unique and intelligent combination of pyrolysis and gasification and can handle charcoal / char yield to up to 25% of the feed in.

For the telecommunication tower segment, Ankur Scientific has developed highly automated small power generation systems with features of remote monitoring and control, auto start / stop with no need for human presence at site. This could also be used for rural electrification with the anchor load being the telecom tower and the balance could be given to the rural areas nearby.

TERI, Mr. Sunil Dhingra

At TERI, we are focussing on sub MW scale two stage gasification systems. Recently, we have developed a two-stage power gasifier in collaboration with the Technical University of Denmark, which produces ultraclean gas. Since the gas does not require any wet cleaning, no waste water is generated, unlike conventional biomass gasifiers. Other salient features of this technology include:

- Low specific fuel consumption
- High overall efficiency
- Highly flexible to take moisture up to 30%
- Very low tar and particulate matter formation

Cummins, Mr. Balaji

Gasification as a sector has always had smaller local players. Cummins has worked on two pilot plants in India and Kenya. We have tied up with Indian Institute of Science (IISc) for the Indian plant in Sattur (Virudhunagar District, Tamil-Nadu)

The 2.5 acre plant uses an *1 MWe IISC Gasifer* along with *2 x Cummins Power Generation QSK38 Lean-Burn Natural Gas Generators,* plus control equipment. The plant has been designed to operate as an independent power provider and plans to generate 8,000 hours electricity per year for the grid. Since it was installed in March 2013, the plant has proven to be environmentally efficient and economical. The plant can operate between 72% - 82% percent overall efficiency, and meets the Indian government's Renewable Energy Certificate criteria.

Potential areas of technological innovation in biomass power sector

Thermax, Dr. Sonde

The technologies available in the sector haven't seen drastic changes. In terms of innovations in gasification systems more efforts need to be directed to gas cooling and cleaning technologies as the quality of gas is critical to the efficiency of the system. From the varied experience that Thermax has had in the sector a few areas where possible intervention can help stimulate the sector include:

- Development of enhanced efficiency power plant cycles in smaller ranges like Organic Rankine Cycle (ORC), Combined Heating & Power Cycle (CHPC)
- Development of state-of-the-art clean-up system without using water and taking the synthesis gas generated from biomass gasification to converting it into methanol.
- Development of appropriate biomass processing and feeding system for mixed quality biomass.
- Development of high efficiency gas engines
- Development of critical components like gravimetric based bio feeding system, Rotating Air Lock (RAV), Wet ESP Design

Ankur Scientific, Mr. Ashok Chaudhuri

The company sees substantial potential in using automated gasification systems for telecom towers as it can save large quantities of diesel and reduce carbon emissions. Moreover, the gasification system can take up the telecom tower load (which can be an anchor load) to provide affordable clean power to rural areas.

TERI, Mr. Sunil Dhingra

The innovations have to be future centric and potential areas could include:

- Development of future energy options like hydrogen and fuel cells based on biomass. R&D initiations need to be in place so that the country can cope up with the increasing energy demand at commercially viable rates.
- Development of poly-generation facilities for the production of liquid fuels, variety of chemicals and hydrogen in addition to power production through IGCC route and establishing the concept of a Bio-refinery.

Cummins, Mr. Balaji

There has been limited development in the biomass sector with respect to design and technology. The opportunity for a group like Cummins is putting a professional approach in a segmented and disintegrated industry which largely only has small time players. The key areas that need intervention in different components of the gasification system are:

- The preparation of the biomass fuel - to process the biomass to reduce moisture content and bring it to desired levels
- Gas cleaning system - Implementing good gas scrubbing and cleaning technology is crucial to the efficiency of the plant and determines the plant performance to a large extent.
- Also efficient utilization of the gas to produce electrical energy through engines (which is where Cummins specializes and can work on developing better technologies) is a necessary area for innovation and improvement.

Prospective pathways to foster innovation in the sector

Thermax, Dr. Sonde	• Gathering adequate support required for R&D from the government's side as well as the industrial players. • Using policy incentives such as viability gap funding to address the technology related barriers to ensure scale of deployment of the technology • Fostering formation of consortia for development of technology platforms
Ankur Scientific, Mr. Ashok Chaudhuri	• Harnessing government support and strengthen implementation of favourable policies like higher tariffs for power sale, GBI etc. • Making waste lands available at concessional rates for the utilization of energy crop plantations and setting up of biomass power plants • Implementation of renewable energy purchase obligations (RPO) on industries & states • Eliminating and reducing the use of fossil fuel based energy generation in industries • Enabling provision of long-term low-interest rate on loans through financial institutions / banks
TERI, Mr. Sunil Dhingra	• Enhancing technology collaborations and partnerships between institutions • Supporting R&D efforts and up-gradation of research facilities for design and testing • Promoting technology adoption and demonstration
Cummins, Mr. Balaji	• Developing innovative indigenous technologies customized for locally available biomass feedstock • Creating a robust and supportive policy framework to help make the environment more investment-friendly • Making more collaborative efforts between academic institutions and the industry. • Allocating portion of government subsidies to pilot projects where new technologies and innovations are being tested.

Outlook for the biomass power sector

Thermax, Dr. Sonde

Given the nature of the agricultural activity the appropriate size of the biomass power outside the bagasse and the rice husk will be in the range of 250 kW – 1 MW. If such standards are developed for these sized biomass power plants using advanced gasification technology with appropriate clean-up technology and high efficiency gas engines, this can actually proliferate pan India if connectivity to the grid and control system is engineered to ensure that the power is fed into the grid as mini IPPs.

Ankur Scientific, Mr. Ashok Chaudhuri

We believe that the technology in the sector is well established and the focus needs to be on the policy front, specifically addressing the following segments:

- Small 500 – 1000 kWe systems connected to the grid
- 50-100 acres of waste land being made available for plantations
- Good tariffs and ease of setting up plants

Interventions in these areas could then help in faster realization of the targets set by the Ministry.

TERI, Mr.Sunil Dhingra

Goal should be focused on bringing the latest gasifier technologies through technological collaborations with the countries which have developed such systems for multi fuels applications.

- There should be development of gasifier systems based on charcoal / pyrolised biomass. R&D efforts are also required for the development of (a) gasifier effluent treatment system (for both small-scale and large-scale gasifiers) and (b) hot gas cleaning systems and optimum integration with the gasifiers.

- Focus on developing future energy options like hydrogen and fuel cells based on biomass. R&D initiations are needed to be in place so that country can cope up with the energy demand at commercially viable options.
- Development of poly-generation facilities for the production of liquid fuels, variety of chemicals and hydrogen in addition to power production through IGCC route and establishing the concept of a Bio-refinery.

Cummins, Mr. Balaji

There is scope for developing cleaner technologies. With more policy support more volume of investment will be seen. Moreover, it will result in lower capital costs and reduced tariffs just like the solar energy industry has seen. The approval process needs to be made simpler. Currently even a 1 MW biomass gasifier plant is classified as a Thermal power plant and it needs to undergo the same amount of due diligence before it can be commissioned. Except the public notice and hearing stage it needs to undergo all the steps. This process can take as long as 5-8 months while ideally for smaller capacity biomass gasification plants the government could consider finishing the process in 2 months instead.

With respect to tariffs a few revisions and modifications could help foster growth in the sector

- Tariff guarantees could be introduced
- Delayed payment by distribution utilities need to be checked or penalized
- Removal of cross subsidy surcharge could be considered for biomass power to motivate more installations
- Generation based subsidies could be introduced

Most of the plants that have shut down are based on older technology. Implementing new technologies such as down draft gasifiers that can tolerate higher levels of moisture content and establishing sustainable biomass feedstock supply chains via biomass plantations could be a way forward for this sector.

Thermax, Dr. Sonde

Dr. R R Sonde serves as the Executive Vice President and member of the Executive Council of Thermax, his main thrust of activities is bringing innovation and enhance knowledge in all the existing technologies within Thermax while also involved in the developing new technologies in the field of energy, environment and water. After 23 years of working in Atomic Energy, he was invited to join as Executive Director to develop new energy technologies at NTPC before he joined Thermax

Cummins, Mr. G. Balaji

Mr. G Balaji is the director of the Cummins Cogeneration India and successfully built the organization structure in India (Chennai) to support the parent organization projects across Africa. A graduate in Mechanical Engineering and Certified Project Management Professional from PMI (USA), he has 28 years of rich experience in the power sector in project Management and Installations across various multinational organizations.

Ankur Scientific, Mr. Ashok Chaudhuri

Mr. A. Chaudhuri is the Senior General Manager at Ankur Scientific Energy Technology Limited. A Professional with over 23 years of experience in varied industries such as Market Research, Engineering, Chemicals and now Renewable Energy, he has been specifically focusing on accelerating business growth and setting up of power plants for decentralized and distributed generation and rural electrification projects in the international

TERI, Mr. Sunil Dhingra

Mr. Sunil Dhingra is a Senior Fellow at The Energy and Resources Institute (TERI). A Mechanical Engineer with a Masters degree from Delhi College of Engineering, he has more than 25 years of experience in the field of clean biomass energy solutions including rural electrification.

EXPERT SPEAK

"Buy and Make Model for Technology can be adopted to Stimulate R&D and Manufacturing"

BioPower India spoke to Mr. Thirumalai N C, Research Scientist, CSTEP on opportunities, gaps and outlook for innovation and technology transfer in biomass power in India.

Biomass power has seen a chequered growth in the country. Do you feel that the target of 10 GW set by the government is achievable? What factors will help stimulate the environment for the sector?

Cumulative biomass power installed capacity is at 4.5 GW today which has a large mix of bagasse based bio-power systems. India's biomass power capacity was more than the installed capacity of solar until recently. So, technology is not the major area for concern. The 10 GW target is achievable provided that certain criterion are met. The biggest area of concern at present is in establishing a robust supply chain for biomass collection as this impact the operational costs to a large extent. There are a few fundamental building blocks that require attention to foster growth in the sector. Building a novel viable models for the improving the supply chain of biomass in necessary.

Learning curves seen from past projects show that establishing good relations, guaranteed businesses etc. with biomass vendors are beneficial.

With respect to technological improvements, biomass combustion systems have a relatively well established technology and are performing fairly well. However, focused intervention is required in gasification technologies.

Which biomass power technology is most suitable for Indian conditions?

From a broader outlook it is recommended if there is a mix of various biomass based technologies. The bigger plan is to achieve 5.5 GW in the next 6 years. A combination of combustion, gasification and bagasse-based plants will ensure optimum utilization of available resources. There is a lot of scope for development in these three technologies. However it is important that these plants are established after meticulous planning based on resource availability.

Controlled combustion or gasification-based systems have substantial potential for growth. Gasification as a technology has seen a lot of interest and development in India. It is suitable for India as it has a range of available capacities, varying from a few kilowatts up to a couple of megawatt. Larger gasification systems have also been set up abroad but maintaining consistent biomass supply would be a considerable challenge unless biomass is sourced from some industry.

What learnings can be adopted from international geographies? What is the scope/requirement for technology transfer in the domain? Which are the firms/institutions taking the lead in this regard?

India can either take the R&D route by developing indigenous technologies right from scratch or transfer the technology and then attempt to reverse engineer the system to customize it to fit the local conditions. There are developers abroad that have done well in terms of developing technologies. The advantage of technology transfer is that one gets a head start and gives a direction for development. A collaborative effort is required in terms of R&D. There are industries that are interested in investing in R&D for gasification in particular as they see a potential market and scope for growth.

One good example of technology transfer is the 1 MW power plant at Ruchi Soya Industries, Washim, Maharashtra set up by Thermax. The plant has been set up based on the MILENA gasification process develop by the Energy Research Centre of the Netherlands (ECN). The plant also has state of the art technology such as the OLGA gas cleaning technology. This plant is a good example of a technology transfer initiative. More such initiatives could help foster growth in technology and innovation in the sector by learning from existing technologies and building on them. Hence in terms of innovation collaborative efforts between Indian industry players like Thermax and Cummins and international organisations like ECN, the Centre National de la Recherche Scientifique (CNRS), France could help encourage in building a positive environment to motivate more innovations in India.

A collaborative effort is required in terms of R&D. A holistic approach needs to be adopted and lacuna in terms of certain specific areas where India can improve on should be looked into.

A holistic approach needs to be adopted - system as a whole needs to be looked at and lacuna in terms of certain specific areas where India can improve on should be looked into.

Can you elaborate on areas where you see opportunities for innovation to foster Biomass Power technology more investment-friendly?

The supply chain of biomass is an area of prime concern. From an investor's perspective surety of a consistent supply of fuel is essential to build confidence to invest. Appropriate due diligence and mapping of the availability of biomass resources can ensure this.

The other challenge that has emerged is that biomass is transported across large distances in the country for biomass power plants. There have been instances where biomass has been transported across states. Currently there are certain biomass power plants operating in Punjab that buy biomass and transport it all the way from Bihar. The expense in terms of transport and its impact on GHG emissions becomes counterproductive to the use of biomass power as a renewable energy technology. Sufficient due diligence is essential before biomass plant is set up, since, unlike other renewable energy sources the availability of the fuel is not as predictable or consistent.

Hybrid biomass power plants also hold a good prospect in terms of growth of the sector. A combination of solar thermal and biomass power could be used to balance the intermittency of solar energy as well as ensure better efficiencies and plant performance. Through hybridisation of these technologies the need for energy storage can also be avoided. A supportive policy framework is also vital to help such innovative efforts succeed.

Hybrid biomass power plants also hold a good prospect in terms of growth of the sector.

The Scalable CSP Optimised Power Plant Engineered with Biomass Integrated Gasification (SCOPEBIG) is one of the first of its kind project in India. The objective of the project is to design, develop and operate a 3 MW grid connected Solar Thermal - Biomass hybrid power plant in Bihar. Under the Indo European Co-operation on Renewable Energy Program, a consortium led by CSTEP along with its Indian (Thermax Limited and Bihar State Power Generation Company Limited) and European partners (Energy Centre of the Netherlands and National Centre for Scientific Research) have been selected to promote development of clean energy technologies for sustainable and inclusive growth in India through this project. This project is funded by the Delegation of the European Union to India.

In this 3 MW plant, the thermal power that goes into the steam cycle is equally distributed amongst solar and biomass in a 50:50 ratio on an annual basis. The final beneficiary of the project is Bihar State Power Generation Company Limited (BSPGCL) which is the generation company in the region where it has been implemented. During the initial stages the project is set to function on a no profit mode, so even the revenue generated in the project will flow back to the project to cater to O&M expenses. This plant is a pilot project in India and the objective is to prove that it is a financially viable model wherein it can be self-reliant to cater to its O&M expenses.

What kind of support from the government can help create an enabling environment for innovations to sprout?

Several combinations of hybrid technologies can be experimented with support from the government. The development of pilot plants can help understand and establish sustainable models that can be further scaled up once proven.

Also, an extensive study needs to be done to assess the availability of resources and biomass. Mapping out the availability of biomass resources can help build a more robust supply chain for biomass.

The buy and make model for technology can be adopted to stimulate more R&D activity as well as manufacturing in India

Alternatively, the biomass power plant developers could tie up with the Food Corporation of India (FCI) as they get adequate quantities biomass from the rice mills. So, along with the de-husked rice obtained from rice mills they could also monetise the rice husk by selling it to biomass power plants. A sustainable mechanism can be developed by trying out a few pilot projects.

Could you share your outlook for the sector (specifically from technology stand point)?

The sector has a promising future. With ample policy support from the government the growth of the sector can be revitalized. The buy and make model for technology can be adopted to stimulate more R&D activity as well as manufacturing in India. Hybridization could be a positive step forward in order to deal with intermittency of other renewable technologies.

The government has strongly advocated the Power for All programs wherein it plans to bring 24x7 reliable power to every household in India by 2019. To cater to the increase in demand India will have to also add considerable amount of power generation capacity. As far as the MNRE is concerned, policy incentives being provided to the biomass power sector are adequate. However, more proactive efforts need to be taken by the regulators.

Mr. Thirumalai N.C. is a Research Scientist involved in the domain of solar thermal system design and experimental aerodynamics at CSTEP. He holds a Bachelor's and Master's degree in Mechanical Engineering. He has over 9 years of experience in the field of R&D.

INDUSTRY SPEAK

Multi-pronged Approach Required to Re-kindle Growth in the sector

Lt. Col. Monish Ahuja (Retd.), Punjab Renewable Energy Systems Pvt Ltd (PRESPL)

Manish Saxena, Punjab Renewable Energy Systems Pvt Ltd (PRESPL)

Biomass power has higher positive socio-economic and environmental impact on the country as whole as compared to other renewable energy (RE) technologies. Biomass based power plants have much higher plant load factor of about 80%-90% while other RE technologies such as wind and solar have PLF in the range of 17% to 25%. Thus, for same power generation capacity (in MW), biomass power plants can generate almost 3.0 to 3.5 times power generated by same capacity of solar or wind energy project. Further, wind and solar energy are highly fluctuating in nature not only from month to month but even during the day which makes power generation from these sources unreliable and as a result, both solar and wind energy cannot provide for base load demand. In contrast, biomass power generation is highly reliable, regular and predictable and can be used to generate uninterrupted power at any point of day or month or season and hence, can help meet the country's base load demand. One of the important aspects of biomass power generation is the boost it provides to the rural economy on account of increased income and employment generation. There is significant income and employment generation in rural areas because of sale of biomass by farmers to the power plant and employment of rural youth and landless labour in biomass logistics chain from farms to boiler tip. Another important aspect of the biomass power generation is that almost 100% of plant's equipment and machinery is currently being manufactured in India leading to employment generation in the country while in case of wind and solar (at large), developers are importing the wind turbines or solar panels due to availability of equipment at lower rates abroad which also result in out flow of precious foreign exchange from the country.

Biomass power has higher positive socio-economic and environmental impact on the country as whole as compared to other renewable energy (RE) technologies

Operational and regulatory challenges in the past have dimmed investor confidence

However, the sector has experienced its share of challenges. Nearly all segments of biomass power value chain, from feedstock supply chain logistics to execution of power project are facing financing challenges. The enthusiasm of both public & private sector financial institutions to lend to the biomass power sector has diminished significantly over last few years due to the current state of the existing biomass power projects. Due to default by many operating biomass power plants, banks/ FIs have become reluctant to provide debt financing to the new projects and even those banks/FIs which are ready to finance these projects, levy high interest rates (in the range of 13% to 15%) resulting in stressed financials of many biomass power plants.

It also needs to be recognized that without adequate debt funding for biomass power projects (which is now under priority sector lending as per new guidelines by RBI in April, 2015), it is impossible to execute new projects in the country and achieve the target set by the government.

There are various barriers to implementation and successful operation of biomass waste to energy projects.

- Non uniform norms for determination of tariff for procurement of power from biomass based power plants across various states has been a key concern. CERC has announced new tariff determination regulations for biomass power plants on 15th May, 2014. However, many SERCs still do not follow CERC norms and follow their own norms which result in low tariff and unviable operations of biomass power plants. Also, irregular tariff revision particularly of variable component of tariff has also worsened the situation.
- There are policy incentives for biomass power by both Central and State Governments. However, due to highly bureaucratic and lengthy procedures, the benefits of incentives such as capital subsidy or providing land for dedicated energy plantation are not actually available to the biomass power plants.
- Before setting up any biomass power plant, a detailed biomass resource assessment in done in catchment area around proposed site. Once the plant's operations start and biomass drawl begins, local farmers/ traders realize the true value of biomass resulting in hoarding and price escalation of biomass leading to unviability of plant's operations.
- Also, there is requirement of separate manpower and machinery to collect, process and transport biomass to the power plant. High expenditure needs to be incurred for fuel collection and processing equipment to maintain uninterrupted fuel supply throughout the year. Fuel Collection is a big challenge and is the key for running the biomass based industry on sustainable basis. Biomass Power Plants have shut down and are not able to sustain high PLF due to supply chain management & biomass pricing issues.
- Unlike solar and wind sector, there are no financial incentives such as generation based incentives (GBI) for the sector which is very much needed for reviving back the interest of developers in biomass power sector.

Banks and FIs are reluctant to finance biomass power projects due to several existing biomass power plants which are not able to service their debt obligations in time due to multiple issues.

Growth in the sector can be rekindled with multi-pronged approach

Growth in the biomass power sector can be re-kindled if all the stakeholders adopt a focussed approach.

Policy makers

The Central Government and the State Governments need to play important role in reviving biomass power sector through following measures:

Growth in the biomass power sector can be re-kindled if all the stakeholders adopt a focussed approach.

The State Govt. to identify and earmark Govt. wastelands near sub-stations which are ideal for setting up the power plants. These lands can be given on long term lease of 20 years to biomass IPPs from the date of commissioning of the plant.

Biomass IPPs to be given a minimum time period of at least 18 months to commission their projects after signing the PPA

Transmission line and required modifications in grid subs-station to be done by the Licensee/ Utilities at free of cost as done in the state of Bihar

Government wastelands to be provided on long term lease to biomass IPPs to develop captive energy plantation as already being done in Rajasthan and Madhya Pradesh. This will also provide impetus to rural economy by way of income and employment generation in energy plantation activities. The plantation development on wastelands can be partially/ fully funded with funds from NCEF.

Providing interest subsidy to biomass based power plant to make them viable and sustainable in long run. Prevailing interest rates are high and varying between 13%- 15% for biomass based projects. Providing interest subsidy in range of 2%-3% will have positive impact on the viability of projects and will attract more project developers.

Providing financial incentives such as generation based incentives (GBI) to the sector, subsidy of import of biomass processing and logistics equipment etc. will boost the investor's sentiment.

Biomass Developers

There is need for the biomass industry to make strong representation to Central Government and State Governments and Central & State Regulators to provide necessary policy and regulatory framework for faster growth and development of the biomass power sector.

Developers need to explore new avenues of financing in addition to conventional ones such as external commercial borrowings or green infrastructure bonds. They also need to adopt efficient combustion and novel fuel logistics and processing technologies which can improve efficiency and reliability of the plants as well as reduce the operational and maintenance costs of the plant.

Biomass fuel Suppliers

There is need for specialized companies in the field of biomass aggregation, processing and supply such as PRESPL (Punjab Renewable Energy Systems Pvt. Ltd.) who can provide end to end solutions for biomass fuel requirement to the biomass power plants. Such specialized fuel supply companies should guarantee both quantity and quality of biomass supply to the power plants at pre- determined prices and thus, acts as single point of contact for all fuel needs of the end customer. On account of assured biomass supply at affordable prices, biomass power plants would be able to operate at high PLF and also service their debt obligations in a timely manner.

There are green shoots of action emerging in the Indian biomass power sector. The sector is bound to grow on account of adoption of CERC RE Tariff regulations by many SERCs including PSERC, BERC, HERC, RERC etc. and upward biomass tariff revision by these SERCs in respective states. Further, Biomass Mission is expected to be announced soon by Hon'ble Prime Minister which is likely to boost the sector in terms of resources and new finance options and schemes. It is expected that Biomass Power sector will play pivotal in achieving RE targets and providing boost to the rural economy in the country.

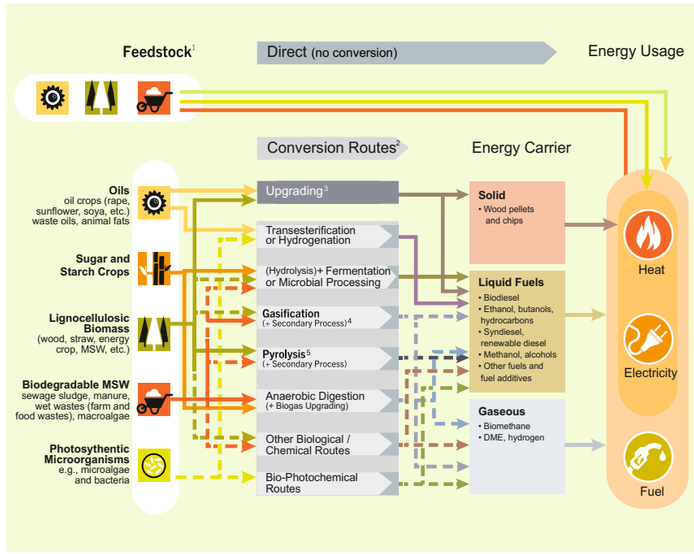
Lt. Col. Monish Ahuja (Retd.) is Director, Bermaco Energy Limited & Managing Director, Punjab Renewable Energy Systems Pvt. Ltd (PRESPL). He set up the first of its kind biomass fuel aggregation and supply company Punjab Renewable Energy Systems Private Limited (PRESPL) in 2011. Monish Ahuja is known in the Biomass fraternity as a dedicated and knowledgeable leader who has represented biomass industry at CERC, SERCs & Forum of Regulators & various National & International forums & conferences.

Manish Saxena, DGM-Business Development & Consultancy, PRESPL is a qualified mechanical engineer and post-graduate in Finance having more than 13 years of rich experience in various sectors such as power, renewable energy (biomass, solar, cogeneration and municipal solid waste), energy efficiency and had worked with many international consulting firms for RE & EE assignments in India & abroad.

Overview of Global Biomass Sector 2015

(This article is an extract from REN 21's Renewables Global Status Report (GSR) 2015 report)

Energy production from biomass is multi-faceted and involves use of many different types of raw and processed biomass which is converted by different technologies to produce energy to be used in different sectors such as commercial, residential and industrial for electricity, heating and transport.



Global energy consumption is witnessing an annual growth of 1.5%. This is mainly driven by the surge in economic activities in developing countries. This increase in energy demand also stimulated growth in renewable energy share in the year 2014 in spite of declining oil prices and increasing energy consumption rate. Renewable energy contributed to approximately 19.1% of the final energy consumption globally in 2013, 9% of which was traditional biomass based energy used for the purpose of cooking and heating in the rural areas. With an increase in biofuel production for the second consecutive year, 2014 saw a significant rise in energy produced as well as installed capacity. 5 GW of capacity addition of biomass based power generation was another highlight of 2014. With increased capacity addition by countries like China, Japan, Brazil and generation by countries like the United States and Germany, the global bio-power generation increased by approximately 9%.

Table: Increase in capacity and generation of bio-fuels

		START 2004	2013	2014
RENEWABLE POWER CAPACITY				
Bio-power capacity	GW	<36	88	93
Bio-power generation	TWh	227	396	433
TRANSPORT				
Biodiesel production (annual)	billion litres	2.4	26.3	29.7
Ethanol production (annual)	billion litres	28.5	87.8	94

The production of bio-heat remained stable in 2014 with a marginal rise of 1% over the previous year. The portfolio for bio-heat generation varied from large scale production as in the United States to small residential scale bio-digesters in China.

Overall, the renewable energy sector saw a rise in investment but the biofuel sub-sector was on a ten year low with a decline of 8%, biomass and waste-to-energy investment too dropped almost 10%. Nevertheless, liquid biofuel production saw the highest increase of 9% in 2014. Although countries like the United States and Brazil dominated the total volume generated, Asia too saw some growth in production production. The increased generation and positive impact on the biofuel market can be attributed to the policies such as the blending mandates which caused an increase in demand for biofuels.

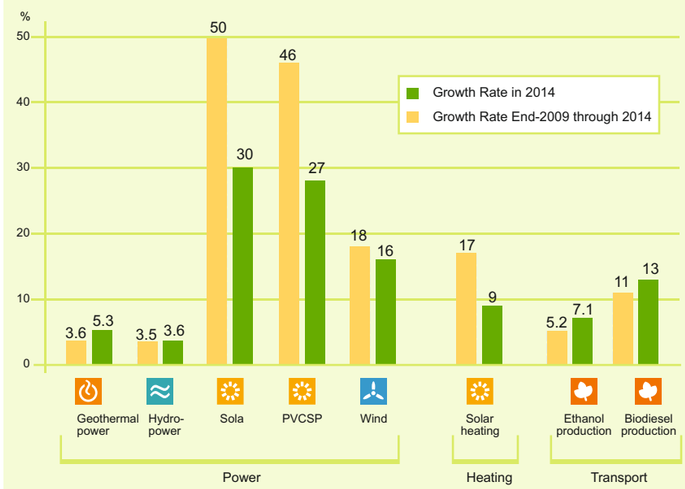
industry speak

The decline in the price of oil during the second half of 2014 also positively impacted the biofuel market though some bioenergy businesses witnessed a decline in the turnover.

Table: Top 5 Countries, 2014

	1	2	3	4	5
ANNUAL INVESTMENT / NET CAPACITY ADDITIONS / PRODUCTION IN 2014					
Biodiesel production	United States	Brazil	Germany	Indonesia	Argentina
Fuel ethano production	United States	Brazil	China	Canada	Thailand
TOTAL CAPACITY OR GENERATION AS OF END-2014					
Biopower generation	United States	Germany	China	Brazil	Japan

Figure: Average Annual Growth Rates of Renewable Energy Capacity and Biofuels Production, End 2009–2014



BIOENERGY MARKETS

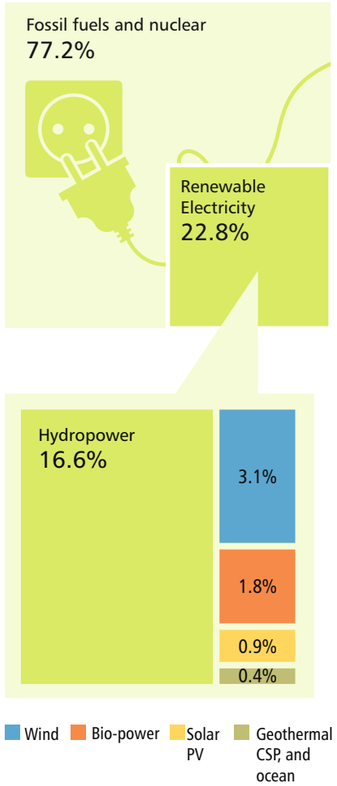
With the total primary energy consumption demand from biomass in 2014 was approximately 16,250 TWh (58.5 EJ), the bioenergy share in total global primary energy consumption has remained steady at around 10% since the year 2000.

In recent years, estimates for the share of traditional biomass in total bioenergy use have ranged from 54% to 60%. This large volume of traditional biomass—consisting of fuelwood, charcoal, agricultural residues, and animal dung—is burned in open fires, kilns, and ovens for cooking and heating applications. After traditional biomass, modern heating accounts for the next-largest share of biomass use for energy purposes. Applications range from residential to industrial scales and may be decentralized or grid-connected, for example through district heating systems. Solid biomass represents the largest share of biomass used for heat and electricity generation, whereas liquid biofuel represents the largest source in the transport sector.

Power Sector

For the year 2014, the most substantial growth in renewables was seen in the power sector. With an increase of 8.5% over 2013 in global renewable power capacity, the total installed capacity is estimated to reach 1,712 GW by the year end. Renewables comprised of approximately 27.7% of the world's power generating capacity. Although bio-power accounted for a meagre 1.8% of the total 22.8% of renewable electricity, developed and developing countries produced a significant amounts of renewable generation from waste biomass associated with agriculture and forestry.

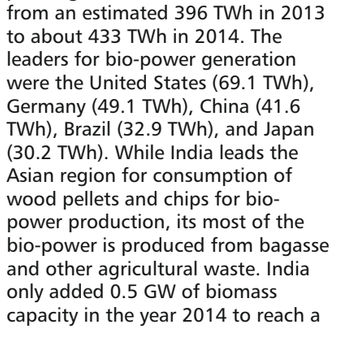
Figure- Estimated Renewable Energy Share of Global Electricity Production, End-2014



Based on renewable generating capacity in operation at year-end 2014.

Figure - Shares of Biomass Sources in Global Heat and Electricity Generation, 2014

Biomass Sources in Heat Generation



Biomass Sources in Electricity Gereration

Bio-power capacity was estimated to have increased by 5 GW in 2014 thus bringing the global total to approximately 93 GW. Bio-power generation also increased, from an estimated 396 TWh in 2013 to about 433 TWh in 2014. The leaders for bio-power generation were the United States (69.1 TWh), Germany (49.1 TWh), China (41.6 TWh), Brazil (32.9 TWh), and Japan (30.2 TWh). While India leads the Asian region for consumption of wood pellets and chips for bio-power production, its most of the bio-power is produced from bagasse and other agricultural waste. India only added 0.5 GW of biomass capacity in the year 2014 to reach a year -end total of 5 GW of capacity. The bio-power market was down relative to the previous year 2012 and 2013 partly due to uncertainty about the feedstock supplies.

Table: status of Bio-power technologies: characteristics and costs

TECHNOLOGY	**TYPICAL CHARACTERISTICS**	**CAPITAL COSTS** USD / kW	**TYPICAL ENERGY COSTS** LCOE – US cents / kWh1
POWER GENERATION			
Bio-power from solid biomass (including co-firing and organic MSW)	Plant size: 0.5–200 MW Conversion efficiency: 25–35% Capacity factor: 25–95%	800–4,500 (Global) Co-fire: 200–800 (Global) Up to 1,000 (China and India)	3–22 (Global) Co-fire: 4–12 (Global) 14 (Europe) 5–6 (China)
Bio-power from gasification	Plant size: 0.03–40 MW Conversion efficiency: 30–40% Capacity factor: 40–80%	2,050–5,500 (Global)	6–24 (Global)
Bio-power from anaerobic digestion	Plant size: 0.075–20 MW Conversion efficiency: 25–40% Capacity factor: 50–90%	Biogas: 500–6,500 Landfill gas: 1,900–2,200	Biogas: 6–19 Landfill gas: 4–6.5

Heating and cooling sector

Almost half of the total energy consumed by the world in 2014 was estimated to be for the purpose of heating. Renewable energy accounted for almost 25% of the total energy use for the heating sector of which traditional biomass accounted for over two-third of the share. Bioenergy accounted more than 90% of the modern renewable energy for the year 2014, with the rest being supplied by solar and geothermal energy. 10% of the total heat demand by the industries was estimated to be met by approximately half of the renewable energy which was almost entirely produced from biomass. The rest of the renewable heat consumption for the purpose of space heating in the buildings, cooking and water heating was primarily derived from biomass, with geothermal and solar contributing minor shares.

Solid, liquid, and gaseous biomass fuels can provide high temperature (200–400 ˚C) for use in industries, district heating, combined heat and power plants (CHP) and agricultural process on combustion. It can also be used to produce low temperatures (<100 ˚C) for heating water, drying, etc. Globally, in 2014 biomass accounted for almost 77% of total global primary energy demand, it was used to produce an estimated 12,500 TWh (45 EJ) of heat, up from 12,360 TWh (44.5 EJ) in 2013. Roughly 70% (8,805 TWh) of this was generated from traditional biomass, which was used for primarily heating purposes in Asia (5,305 TWh or 19.1 EJ) and Africa (3,222 TWh or 11.6 EJ). In 2014, Europe remained the world's largest consumer of modern bio-heat, most of which was used in Sweden, Finland, Germany, France, and Italy.

Biogas also accounted for a significant amount of heat production in Asia. India also installed more than 82,730 family biogas digesters in 2014, bringing its total to 4.75 million.

Table: status of bio-heating technologies: characteristics and costs

TECHNOLOGY	TYPICAL CHARACTERISTICS	CAPITAL COSTS USD / kW	TYPICAL ENERGY COSTS LCOE – US cents / kWh1
HOT WATER / HEATING / COOLING			
Biomass heat plant	Plant size: 0.1–15 Mwth Capacity factor:~50–90% Conversion efficiency: 80–90%	400–1,500	4.7–29
Wood pellet heater (domestic)	Plant size: 5–100 Mwth Capacity factor: 15–30% Conversion efficiency: 80–95%	360–1,400	6.5–36
Biomass CHP	Plant size: 0.5–100 kWth Capacity factor: ~60–80% Conversion efficiency: 70–80%	600–6,000	4.3–12.6

Transport Sector

Although the primary focus in terms of use of renewable energy for transport sector is liquid biofuels, renewables may also have an entry point in the sector through the growing electrification and use of natural gas in the transport sector. The share of renewable energy in the sector is pretty low. It was estimated that there was only a meagre demand of 3.5% renewable energy for road transport in 2013 of which liquid biofuel (ethanol and biodiesel) contributed the maximum share. Biofuel contribution in the transportation sector was found to be high (exceeding 20%) in some European countries, the United States and Brazil, where the share of biofuel in the sector for 2014. Other than liquid biofuels, gaseous biofuels like bio-methane are also increasingly finding space in the transport sector. Indian Railways too committed in 2014 to use up to 5% biofuels for the trains.

Table: status of bio-fuel technologies: characteristics and costs

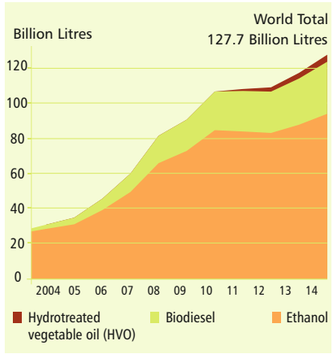
TECHNOLOGY	FEEDSTOCKS	FEEDSTOCK CHARACTERISTICS	ESTIMATED PRODUCTION COSTS US cents / litre[1]
TRANSPORT FUELS			
Biodiesel	Soy, rapeseed, mustard seed, palm, jatropha, waste vegetable oils, animal fats	Range of feedstocks with different crop yields per hectare; hence, production costs vary widely among countries. Co-products include high-protein meal.	Soybean oil: 56–72 (Argentina); 100–120 (Global average) Palm oil: 100–130 (Indonesia, Malaysia, and other) Rapeseed oil: 105–130 (EU)
Ethanol	Sugar cane, sugar beets, corn, cassava, sorghum, wheat (and cellulose in the future)	Range of feedstocks with wide yield and cost variations. Co-products include animal feed, heat and power from bagasse residues. Advanced biofuels are not yet fully commercial and have higher costs.	Sugar cane: 82–93 (Brazil) Corn (dry mill): 85–128 (United States)

2014 saw a 9% increase in global biofuel production to a total of 127.7 billion litres, with each type of biofuel reaching its highest level to date. Fuel ethanol accounted for 74% of the total, biodiesel largely from fatty acid methyl ester (FAME) accounted 23%, and hydrotreated vegetable oil (HVO) accounted for limited but increasing quantities. The top countries for total production of biofuels were the United States, Brazil, Germany, China, and Argentina.

Global fuel ethanol production was up 7% to 94 billion litres. The increase was largely due to good corn and sugarcane harvests and low crude oil prices, which kept the production costs low. Ethanol production in India too was estimated to have increased by 46%.

Global production of biodiesel (mainly FAME) increased 13% to 30 billion litres. The top producers were the United States (16% of the global total), Brazil and Germany (both with 11% of the global total), Indonesia (10% of the global total), and Argentina (9.7% of the global total). Biodiesel production substantially increased in Asia too in 2014. Indonesia led the region, with production up 41% to 3.1 billion litres. Despite the deregulation of diesel prices in India, initiative of blending biodiesels in the Indian Railways and allowances to producers to sell to the end consumers directly biodiesel production experienced a marginal declined.

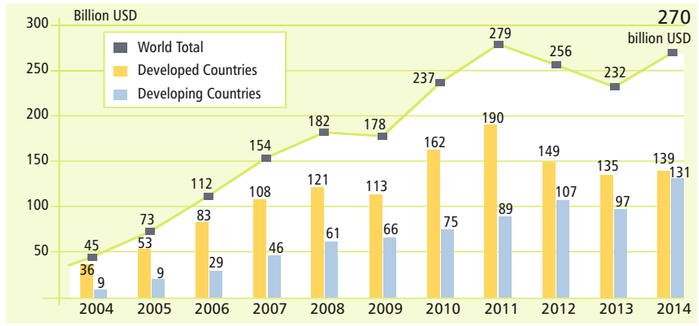
Figure: Ethanol, Biodiesel, and HVO Global Production, 2004–2014



Investment flows

Bloomberg New Energy Finance (BNEF) estimated the global new investment in renewable power and fuels (excluding hydropower projects >50 MW) to be USD 270.2 billion in 2014. This estimation represented a rise of almost 17% compared to 2013 and the first increase in the last three years. Including investments in hydropower projects larger than 50 MW, total new investment in renewable power and fuels for 2014 was estimated to be at least USD 301 billion. However, biofuel investment reached a 10 year low and saw an 8% decline to USD 5.1 billion, biomass and waste-to-energy investment too dropped 10% to USD 8.4 billion.

Figure: Global New Investment in Renewable Power and Fuels, Developed and Developing Countries, 2004–2014.



Note: Estimates do not include investment in renewable heating & cooling technologies

Developed and developing countries alike saw increase in renewable energy investments during the year 2014 in comparison to previous years. While developed countries noted a moderate increase of 3%, to USD 138.9 billion, developing economies including India, China and Brazil as a group saw an increase of 36%, to USD 131.3 billion. This large increase in investment in renewable energy resulted a 49% of rise in the share of global investment by the developing nations in 2014; thus setting a new record. India's renewable energy investment also rose from USD 1 billion to USD 7.4 billion like its other global counterparts.

Figure: Global New Investment in Renewable Power & Fuels in India 2004-14

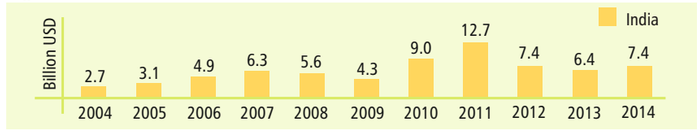
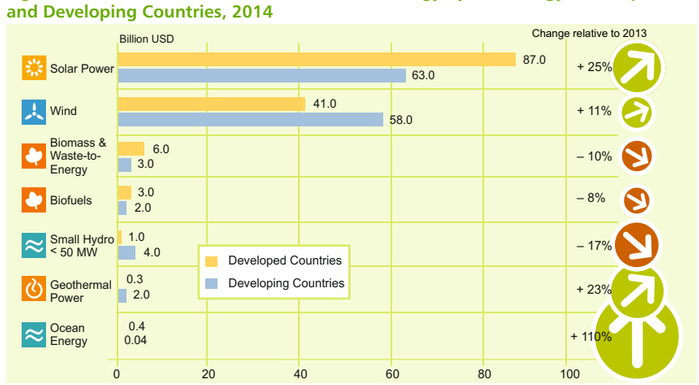


Figure: Global New Investment in Renewable Energy by Technology, Developed and Developing Countries, 2014



Policy Landscape

Most countries have enacted policies in order to regulate and promote renewable sources in the field of power generation, heating and cooling and transport sectors, at the same timemitigate climate change, develop more resilient and flexible energy systems, reduce dependence on imported fuels and create economic opportunity.

As of early 2015, policies in support of renewable energy were found in 145 countries, which rose up from 138 in 2014. New policy adoption has shown a stunted increase as majority of the nations have already adopted some or the other form of renewable energy support. Hence, policymakers have shifted their focus to adaption of existing policies in order to keep pace with the rapidly changing circumstances.

Strategies to promote renewable energy has also expanded and evolved at regional level. In 2014, the European Union established new regulations governing the energy sector beyond 2020 by setting a region-wide goal of a 27% renewable energy share by 2030. Also in 2014, with the adoption of the Arab Renewable Energy Framework (AREF), the Arab League and its 22 member states joined other regions around the world including the EU and the Caribbean Community (CARICOM) in establishing a regional framework for renewable energy development and deployment. The AREF builds on the Pan-Arab Strategy for the Development of Renewable Energy Applications: 2010–2030, which was adopted in 2013.

India too took a stance in established of an overall goal of 170 GW of renewable energy by 2022. It also increased its solar power target to 100 GW by 2022 which is five times greater than the original goal and also inaugurated the National Mission on Small Hydro, which includes hydropower targets. The United States and India agreed on bilateral commitments to scale up renewable energy development, with the United States pledging USD 2 billion to support India's renewable energy and climate goals.

Conclusion

There has been an increase in awareness with regard to renewable sources of energy and its importance in mitigation and adaption to climate change. Renewable energy can also play an active role in increasing energy system resilience. With the growing demand for energy and depleting resources, renewable form of energy are very important as they have a low carbon footprint and are also abundantly available. It is hence imperative that policy and incentives help expand and promote the renewable market to provide energy access to all without depleting the fossil fuels or increasing the pollution levels.

Policy Updates

OERC releases a regulation on obligations for procurement from renewable energy sources

Issue Date - 10th October, 2015

Odisha Electricity Regulatory Commission (OERC) released a notification on the targets set for procurement from renewable energy sources. The regulation is to be called OERC (Procurement of Energy Renewable Sources and its Compliance) Regulations, 2015. The regulation is aimed at promoting sale of power from renewable energy sources to any person in the state of Odisha.

These regulations are applicable to distribution licensees or any other party procuring power on their behalf. Also to any person consuming electricity under the following conditions:

- Generated from Conventional Captive Generating plant having capacity of 1MW and above for his own use and or
- Procured from conventional generation through open access and third party sale.

Under the regulation every obligated entity is required to meet its RPO target from its own renewable energy generation source, by purchasing of REC's or by procuring of power from other developer of renewable energy sources. The minimum target to be procured from renewable energy sources are as given below:

Sr. No	Year Wise Target	Solar Source (%)	Non-Solar (%)	Total (%)
1	2015 -2016	0.50	2.50	3.00
2	2016 -2017	1.50	3.00	4.50
3	2017 -2018	3.00	4.50	7.50
4	2018 -2019	4.50	5.00	9.50
5	2019 -2020	5.50	5.50	11.00

Source: http://www.orierc.org/Gazette%201301-2015.pdf

Continuation of Biogas Power (off-grid) Programme for decentralized power generation applications and thermal applications during 2015-16 and the remaining period of 12th Five Year Plan

Issue Date - 30th November, 2015

In continuation to MNRE's sanction dated 26.08.2014, the Biogas Power (off-grid) Programme for decentralized power generation applications (in the range 3 - 250kW) and thermal applications has been continued for 2015-16. Under the scheme, the Central Financial Assistance (CFA) will be provided on the power generation capacity of biogas plants.

As per the scheme, the installation/commissioning of biogas power plants should be completed within a year (and maximum 18 months) from the date of sanction of the project. Successful commissioning would be defined by operation of the project for three months, including 72 hours continuous operation at a minimum of 80% of rated capacity supported by verified data logged by the project. The plants will be operated for minimum 10 hours per-day. The developer will be required to provide regular (every 6 months) plant performance data to MNRE.

Pattern of CFA

Power Generating Capacity	Biogas Plant capacity	Requirement of DPR	CFA/Subsidy limited to the following ceiling or 40% of the cost of the system whichever is less		Administrative charges to State Nodal Departments/Agencies/BDTCs for providing technical, supervision, training support and submission of project completion and monitoring report of successful operation	
			Power Generation	Thermal Application	Power Generation	Thermal Application
3-20kW	25 m3 to 85 m3	No DPR required	Rs 40,000/kW	Rs 20,000/kWeq	10% of the CFA	5% of the CFA
>20kW to 100kW	Any combination of the above plants or approved/alternate capacity design	DPR required	Rs 35,000/kW	Rs 17,500/kWeq	Rs 1,00,000	Rs 50,000
>100kW to 250kW	Any combination of the above plants or approved/ alternate capacity design	DPR required	Rs 30,000/kW	Rs 15,000/kWeq	Rs 1,50,000	Rs 75,000

The other terms and conditions and outlay for the Scheme will remain unchanged.

Source: http://mnre.gov.in/file-manager/offgrid-biogas/biogaspower-2015-16.pdf

Disclaimer: The regulations presented here are summaries of the original and should not be referenced for legal or commercial purposes. For the original regulations, refer to the websites of the issuing agency.

BOOK REVIEW

Review of REN21's Renewables Global Status Report (GSR) 2015

Our recommended read for the quarter is **REN21's Renewables Global Status Report (GSR) 2015.** The report provides a comprehensive insight of the renewable energy market, investment, industry and policy developments worldwide. It gives an accurate synopsis of the progress of renewables globally and enables policymakers, industry, investors and civil society to make informed decisions.

Despite the substantial decline in oil prices during the second half of the year, renewable energy continued to grow through 2014. The capacity addition and generation continued to expand in 2014 following the trend from 2013 where renewable energy accounted for 19.1% of the global energy consumption. Renewables accounted for approximately 58.5% of net additions to global power capacity in 2014. The power sector saw the maximum growth and increase in capacity, primarily led by solar PV, wind and hydropower. By the end of the year, the contribution of renewables to the world's power generating capacity was 27.7%. These additions enabled the renewables to power an estimated 22.8% of global electricity demand.

The growth in the sector can be attributed to several factors such as renewable energy support policies and the nearing reality of achieving grid parity from different renewable energy sources. In most countries renewables are already at par with conventional energy sources. As in the past, government policies were critical in shaping the development of renewable energy. Many countries also came out with their new renewable energy targets, and several countries made ambitious commitments such as declaring 100% renewable energy or electricity targets. By early 2015 about a total of 164 countries had set their renewable energy targets, and an approximately 145 countries had initiated renewable energy support policies.

China led the world in terms of the capacity installations in 2014 even though Europe was a leader in innovations and markets. Developing nations such as Brazil, India and South Africa were also responsible for substantial capacity additions in their respective regions. To support the intermittency challenge of renewables such as wind and solar the deployment and development of energy storage systems also saw significant growth in 2014.

Focusing on the biomass based power generation, it was noted that the global bio-power production increased nearly 9%, with the United States and Germany leading for generation (despite comparatively smaller capacity additions), whereas China, Brazil, and Japan led the front in capacity additions. Overall, 75% of the electricity generation from biomass sources is dependent on solid biomass based fuels followed by 17% biogas and 7% MSW.

However, the continuing support shown towards fossil fuels and nuclear power through subsidies in developing nations has acted as a deterrent to the growth of the renewable energy sector. Also, certain policy changes and uncertainties posed a challenge to the development of the renewable energy sector. Two prominent actions were the imposition of taxes on generation from renewable energy sources in Europe and expiration of the renewable electricity production tax credit (PTC) in US.

Country and their Biomass Power Generation Trends

Biomass based power capacity grew by an estimated 5 GW in 2014, leading to the global total amounting to approximately 93 GW. Its production also increased by an estimated 37 TWh in 2014, bringing the global number to a total of 433 TWh. The leaders in terms of biomass power generation were the United States (69.1 TWh), Germany (49.1 TWh), China (41.6 TWh), Brazil (32.9 TWh), and Japan (30.2 TWh).

Even though the United States added only a total of 0.3 GW in 2014 (down about 50% from 2013), it remained the global leader in terms of capacity installed with 16.1 GW in operation at year's end. The US has had the highest capacity because the bio-power is primarily derived from wood and agriculture based residues burned in co-generation plants. Electricity generation based on woody biomass increased by 6% to 42 TWh, the generation from waste biomass declined by 2% to 19.7 TWh in 2014.

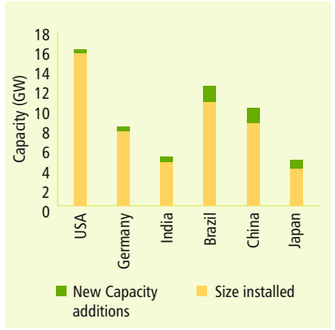
China saw a substantial increase in generation capacity in 2014 wherein 1.5 GW of bio-power capacity was added raising the total to 10 GW of which agro and forest based residues accounted for the largest share (about 53%), thus making China Asia's largest consumer wood pellets and chips. Municipal solid waste also had a substantial contribution to China's new capacity (about 45%). In 2014, Japan added more than 0.9 GW of new solid biomass capacity most of which was MSW based bio-power, for an estimated total of 4.7 GW.

India saw a capacity addition of 0.5 GW amounting to a total of 5 GW by the year's end. Due to lack of adequate feedstock supplies the market was relatively down from 2012 and 2013. Despite of being one of the largest consumers of wood pellets for biomass power production, a majority of India's bio power is produced from bagasse and other agricultural residues.

With respect to both biomass power generation and capacity, Europe stands out with roughly 36.5 GW in operation at the end of 2014. The United Kingdom and Germany were the highlights in terms of capacity additions in 2014 with 0.5 GW (including partial conversion of a coal-fired power plant to solid biomass based power plant) and 0.4 GW respectively. In total EU generated approximately 81.6 TWh from solid biomass in 2014. The top five producers in EU were - Germany, Finland, the United Kingdom, Sweden, and Poland which attributed up to 63% of the region's bio-power production. Even though a number of countries use biomass only for electricity generation dedicatedly, about 65% of the EU's biomass power was generated in CHP plants in 2014, up from 63% in 2013.

Brazil's bio-power sector has seen a steady growth with an estimated 1.49 GW of new capacity addition bringing the total to 12.3 GW in 2014. Electricity generation in Brazil is primarily based on sugarcane bagasse and black liquor and remained stable at about 7.6% of Brazil's total electricity generation.

Africa had also seen modest bio-power production. The bio-power sector predominantly consists of captive power plants based in all the sugarcane mills in the region. Some of the African nations such as Ethiopia, Kenya, Mauritius, Sierra Leone, Sudan, and Uganda even feed in the surplus electricity into the national grid. Moreover, some pilot projects were tested in Nigeria based on waste-to-energy in 2014.



Overall, the renewables saw a steady growth rate in 2014 which was primarily driven by developing nations. Due to the increased penetration of renewables, the global carbon emissions associated with energy didn't get altered for the first time in four decades. Even though the biomass sector didn't see a drastic growth rate in 2014, the continual capacity additions and investments reflected that there is still a lot of untapped potential in the domain. With the consistently increasing power demand, bio-power sector will have to continue to compliment the other sources of renewable energy such as wind and solar.

The complete report can be downloaded at http://www.ren21.net/wpcontent/uploads/2015/07/REN12-GSR2015_Onlinebook_low1.pdf

AROUND THE WORLD

News

Punjab to become bioenergy leader in couple of years

October 29, 2015:

A bio-refinery is proposed to be set up in Punjab which will not only solve the issue of air pollution caused due to open combustion of the biomass but will also provide a means of livelihood generation for the farmers by purchasing the feedstock from them periodically. Following the discussion at the Progressive Punjab Investor Summit, 2015 a Memorandum of Understanding (MoU) for setting up a bio-refinery was signed by a consortium consisting of Beta Renewables, Novozymes and CVC India Infrastructure Pvt. Ltd., for an estimated project worth INR 950 crore. The chairman of CVC India Infrastructure Pvt. Ltd. Mr. K Krishnan also introduced the conceptual plan for setting up Asia's first second generation bio-ethanol producing refinery. This project is set to draw further investment of an estimated USD 1billion.

More over 12 other MoUs were inked worth INR 21,305 crore which a Biomass Power Plant by Sukhbir Agro Energy Ltd., a 100 MW waste-to-energy projects by AG Dauters Consulting Pvt. Ltd.,

Private investors had led to investments of over INR 4000 crores in the renewable energy space in Punjab over the last three years. Progressive policies have persuaded Non-Resident Indians (NRIs), foreign companies and leading Indian companies to invest in the sector.

Source:http://www.thehindu.com/news/national/tamil-nadu/punjab-to-set-up-bioethanol-refinery/article7820930.ece

Government to involve financial institutions to help revive stalled biomass power plants

November 1, 2015:

In an effort to revive stalled biomass power projects the government is looking to involve financial institutions to explore options in extending funds to existing developers of such plants. Several plants have been non-operational due to multiple barriers such as high operational costs and regulatory issues. Revival of such plants would give a boost to India's ambitious plan of achieving 175 GW of renewable energy generation capacity.

The government is implementing a project assisted by the Ministry of New and Renewable Energy (MNRE)-UNDP/GEF on 'Removal of barriers to biomass power generation in India'.

In order to tackle some of these challenges and to improve viability of biomass power projects the MNRE ministry has proposed a scheme - "MNRE-UNDP/GEF Biomass Power Project Refinance Scheme" to assist the revival of existing biomass power projects that were affected due to unforeseen circumstances. Funds of about INR 15 crore are to be released for the scheme. It was also proposed that the fund will be primarily allocated to those plants which have a potential to be revived in a short time period. Interested banks and FIs may to submit their proposals for refinancing, the ministry added. The net gird-connected biomass power generation capacity stands at 1,410 MW as on 31st March, 2015.

Since the project viability and ability to repay the loan have also been a challenge, refinancing of the loans outstanding will be done at concessional interest rates to overcome the challenge.

Source: http://www.business-standard.com/article/pti-stories/govt-may-turn-to-fis-to-restart-stalled-biomass-projects-115110100136_1.html

NTPC's debut 'masala' bond may be green one

18 Nov 2015:

It was recently reported that the NTPC's debut 'masala bond' could likely be a rupee denominated green bond.

"The dollar-denominated bonds which we issue in the market are used for capital expenditure and our ongoing projects. This (rupee-bond issue) will be a green bond issue and may be used for some other purpose," a source close to the development said.

Source: http://www.financialexpress.com/article/industry/companies/ntpcs-debut-masala-bond-may-be-green-one/167155/

IDBI Bank raises ₹2,310 crore via green bonds

26 Nov, 2015:

IDBI Bank Ltd on Thursday announced it had raised $350 million (₹2,310 crore) from the issuance of green bonds to fund renewable energy projects. The issue was made under the $5 billion medium term note (MTN) programme listed on Singapore Stock Exchange, IDBI Bank said in a statement.

IDBI has become the first state-owned commercial bank to raise $350 million by selling green bonds. The proceeds from these bonds will be used for refinancing of clean energy projects assisted by the bank. It will also be used to finance new projects including sustainable transportation, amongst others.

In order to maintain transparency, and provide comfort for the investors, the bank will also have the green bonds certified by a third party for the end use of the proceeds.

Source: http://www.livemint.com/Industry/hdjc06LrzjGD3fZKCOpq1M/IDBI-Bank-raises-Rs2310-crore-via-green-bonds.html

India ranks 5th on ease of doing clean energy business

10 Dec, 2015:

Owing to the notable policy reforms in the renewable energy sector in India, Bloomberg New Energy Finance ranked India at fifth place on a list of 30 countries on ease of doing business in the renewable energy space.

The ranking was done as a part of BNEF's annual Climatescope report. The report also indicates that the clean energy's centre of gravity is shifting from developed to developing countries wherein China was ranked at first place followed by Chile, Brazil, South Africa and India. The strongest criterion favouring India was value chain, while insubstantial investment in the sector continues to be the weak link. Total clean energy investments in India stood at $52.5 billion from 2009-14.

The report said "Major reforms in India brought by the Modi administration bring hope of quicker deployment for the country's eager renewable energy developers." Further the report highlighted Tamil Nadu as the state with highest wind energy generation potential followed by Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Gujarat. Moreover Madhya Pradesh ranked the highest with respect to renewable energy investments. The state's favourable land policy and easily released clearances have resulted in attracting projects.

At 7.4 GW Tamil Nadu has the highest installed wind energy capacity in India but the rate of capacity addition has declined in 2014 wherein only 208 MW was commissioned. This was primarily due to the poor financial health of the state distribution companies coupled with the payment delays to power project owners.

On the other hand states like Gujarat which was once the centre for clean energy investments slipped due to uncertain policy framework and issues with tariff regulation. While Maharashtra saw considerable investment in wind propelled by high feed in tariffs, it failed to encourage private investment in the solar energy sector due to lack of tenders and non-availability of feed in tariffs.

Rajasthan reflected highest renewable share (32%) of the total power capacity of 13 GW, compared to other states. Even though the overall renewable energy capacity grew by an estimated 14% in 2014, the state saw limited policy incentives to draw more investment in solar development. Also, the state's distribution companies are one of the most financially unstable in India.

Source: http://www.business-standard.com/article/economy-policy/india-5th-on-doing-biz-in-clean-energy-115112300009_1.html

NGT directs Punjab government to help dispose agricultural residue sustainably

12 Dec, 2015:

The National Green Tribunal (NGT) directed the Punjab government to ensure that the agricultural residue isn't burnt in the open and to help farmers by providing adequate machinery and mechanisms to dispose the waste more sustainably.

The pollution levels in the Delhi NCR region have risen to alarming rates more so with the onset of winters and weak winds during the season. The weaker winds also results in the particulate matter lingering in the air for longer. Burning agricultural residue has been noted as a major contributor to Delhi's pollution woes. Neighbouring states like Punjab and Haryana were prime contributors to the same with an estimated 15 metric tonnes of paddy straw burnt every year in Punjab.

The NGT Chairperson Justice Swatanter Kumar also said that the processing and disposal equipment should be provided free of cost to those farmers having less than 2 acres. While for farmers having less than five acres but more than two acres, the price should be INR 5000 and for the rest, it to be INR 15,000.

"Farmers must be educated of how crop residue burning is injurious to human health, causes serious air pollution and is now banned or prohibited by law. They shall also be educated that the agriculture residue can be extracted and utilised for various purposes including manufacturing of boards, fodder, rough paper manufacturing and as a raw material for power generation etc," the order quoted.

Additionally the NGT also announced fines for those who were found violating the order. The NGT also directed the Pollution Control Board (PCB) to monitor ambient air quality and asked all the district magistrates to form special monitoring teams to physically inspect sites and ensure that no agricultural residue was being burnt in their respective jurisdictions.

Source: http://indianexpress.com/article/india/india-news-india/help-small-farmers-dispose-of-agri-residue-ngt-tells-punjab-govt/

The global biomass pellet market is expected to grow at a CAGR of 11.1% during 2015-20

12 Dec, 2015:

The global biomass pellet market was valued at $6,976.3 million in 2014. According to a report from P&S Market Research the market is expected to grow with a CAGR of 11.1% during 2015-2020.

The key drivers for the growth in the market consist of low GHG emissions from biomass, need for alternative energy sources, increased government initiatives for renewable energy technologies and a substantial untapped biomass potential.

Various government incentives such as schemes, grants and subsidies have encouraged adoption of renewable energy.

With an increasing threat from global warming and rapid depletion of fossil fuels the centre of gravity has shifted from conventional energy sources to cleaner energy alternatives.

Europe held the largest share of the global biomass pellet market in 2014, in terms of value and volume. The primary reasons for the immense growth are increased government incentives to adopt the energy source and the lower GHG emissions from biomass. Hence, the European market is expected to sustain the growth rate majorly driven by various subsidies and incentives from the governments.

The incentives for turning over to biomass in U.K. are aimed at supporting infrastructural development primarily. The drastically declining rates for renewables coupled with the increasing costs of burning fossil fuels are providing a fillip to adopting biomass as a substitute to it. This trend is expected to support the growth of the European biomass pellets market.

However, Asia's biomass pellet market is expected to witness a faster growth, of early 21.6% CAGR globally during 2015-2020. The demand for biomass pellets in Asia is primarily driven by China, Japan and South Korea. The Renewable Energy Law introduced on 1st January 2006 in China had put adoption of biomass fuel at top of their priority. Biomass pellets have primarily received considerable attention as a replacement for coal in China and it is expected to grow at a steady rate. Therefore China's growing interest in the adoption of biomass fuels is expected to drive the growth of the Asian biomass pellets market.

Source: http://www.prnewswire.com/news-releases/global-biomass-pellet-market-is-expected-to-grow-with-11-cagr-during-2015-2020-ps-market-research-562315061.html

AROUND THE WORLD

Datebook

13th International Conference on Biofuels

Date	:	18-19 January 2016
Location	:	Berlin, Germany
Type of event	:	Conference
Organizer	:	German Bioenergy Association (BBE)
Key themes	:	The conference will cover roundtable/panel discussions on biodiesel, bioethanol, bio -methane, vegetable oil and advanced biofuels. The prospect of biofuels till 2020 and beyond will be discussed and thoughts will be shared on the experiences with the reduction in GHG emissions by introduction of biofuels.
Link	:	http://www.fuels-of-the-future.com/

World Future Energy Summit 2016

Date	:	18-21 January 2016
Location	:	Abu Dhabi, United Arab Emirates
Type of event	:	Exhibition / Conference
Organizer	:	Reed Exhibitions
Key themes	:	The discussions at the conference will be focused towards decarbonization and climate resilience in the energy sector and how renewables are to be blended into the present energy mix.
Link	:	http://www.worldfutureenergysummit.com/

The World Electricity Forum 2016 - ELECRAMA – 2016

Date	:	13-17 February 2016
Location	:	Banglore, India
Type of event	:	Exhibition / Conference
Organizer	:	Indian Electrical & Electronics Manufacturers' Association (IEEMA)
Key themes	:	The conference is a platform where technology presentations, concepts and pure business interactions will take place on key issues such as upcoming product & technology, new specs & standards. The conference will draw in policy makers, regulators, officials of power utilities, representatives of funding agencies, technical specialists and consultants, electrical equipment buyers, engineering project contractors and members of the academic community from India and abroad.
Link	:	http://elecrama.com/

Sustainable Energy & Technology Asia (SETA) 2016

Date	:	23-25 March 2016
Location	:	Bangkok International Trade & Exhibition Center(BITEC), Bangkok (Thailand)
Type of event	:	Exhibition / Conference
Organizer	:	GAT International
Key themes	:	The theme of conference is focused on four broad areas energy policy and planning, electrical system technologies, transportation and alternative fuels, sustainable energy & green technology. The event also has an exhibition which will be attended by over 2,500 visitors & delegates from the power, energy, technology & utility industries.
Link	:	http://www.seta.asia/

Scheme to Support Promotion of Grid Interactive Biomass Power and Bagasse Cogeneration in Sugar Mills in the Country during the 12th Plan Period

The Ministry of New and Renewable Energy announced the extension of Central Financial Assistance (CFA) for "Promotion of Grid Interactive Biomass Power and Bagasse Cogeneration in Sugar Mills" during the 12th Plan period at a total cost of INR 310 Crores only.

Under this scheme, the capital subsidy is provided for setting up of biomass combustion based power plants and bagasse cogeneration projects in private/cooperative/public sector sugar mills:

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

The amount of CFA for biomass combustion power projects would be calculated based on installed capacity and for bagasse cogeneration project in sugar mills on surplus power exported to grid.

CFA for Biomass Power Project and Bagasse Cogeneration Projects by Private/ Joint/Coop./ Public Sector Sugar Mills

Types of Project	Capital Subsidy for Special Category States (NE Region, Sikkim, J&K, HP & Uttarakhand)	Capital Subsidy (Other states)
Biomass Power projects	INR 25 lakh X © MW) (Max. support of INR 1.5 Cr per project.)	INR 20 lakh X (C MW) (Max. support of INR 1.5 Cr per roject.)
Bagasse Cogeneration by Private sugar mills*	INR 18 lakh X (C MW) (Max. support of INR 1.5 Cr per project.)	INR 15 lakh X (C MW) (Max. support of INR 1.5 Cr per project.)
Bagasse Co-generation projects by cooperative/ public sector sugar mills*	Rs.40 lakh (40 bar & above) Rs.50 lakh (60 bar & above) Rs.60 lakh (80 bar & above) per MW of surplus power@ (max. support INR 6.0 crore per project)	Rs.40 lakh (40 bar & above) Rs.50 lakh (60 bar & above) Rs.60 lakh (80 bar & above) per MW of surplus power@ (max. support INR 6.0 crore per project)

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

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

Here C is the capacity in MW.

For further details please refer
http://mnre.gov.in/file-manager/grid-biomass/scheme-Biomass.pdf