DEVELOPMENTS IN HARNESSING OF BIO-MASS POWER

Biomass is a source of renewable energy which is biological material derived from living or recently living organisms such as wood, waste and alcohol fuels. Mostly they are common plant matter. Forest residues such as dead trees, branches, tree stumps, wood chips etc may be used as biomass. They may also include biodegradable wastes that can be burnt as fuel. It excludes organic material such as fossil fuels which have been transformed by geological processes into substances such as coal or petroleum. Biomass is carbon based and is composed of a mixture of organic molecules containing hydrogen, usually including atoms of oxygen, often nitrogen and small quantities of other atoms like alkali etc.

Biomass energy is derived from three distinct energy sources; wood, waste and alcohol fuels. The largest source of energy from wood is pulping liquor, a waste product from processes of the pulp, paper and paperboard industry. The main contributors of waste energy are municipal solid waste, manufacturing waste and landfill gas. Biomass alcohol fuel, or ethanol is derived almost exclusively from corn. Biomass can be converted to other usable forms of energy like methane gas or transportation fuels like ethanol and bio-diesel. Crops like corn and sugar cane can be fermented to produce the transportation fuel, ethanol.

The current availability of biomass in India is estimated at about 500 million metric ton per year. A potential for generation up to 16000 MW from biomass energy is estimated from the estimated surplus biomass available covering agricultural and forestry residues. In addition, about 5000 MW of power can be generated through bagasse based cogeneration in the country's 550 sugar mills, provided these mills adopt technically and economically optimal levels of co generation in extracting power from bagasse produced by them.

The Ministry (MNRE) has been implementing biomass power/cogeneration programs for more than 10 years. A total of 203 biomass power and cogeneration projects aggregating to 1677 MW capacity have been installed in the country for feeding power to the grid till November 2008. In addition, around 171 biomass power and cogeneration projects aggregating to 1850 MW of electricity are under

various stages of implementation. Cogeneration projects in sugar mills includes 82 projects with installed capacity aggregating to 1280MW. States which have taken leadership position for implementation of cogeneration projects are Andhra Pradesh, Tamil nadu, Karnataka and Uttar Pradesh. The leading states for biomass power projects are Andhra pradesh, Karnataka, Chattisgarh, Maharashtra and Tamilnadu.

STATE-WISE/YEAR-WISE LIST OF COMMISSIONED BIOMASS POWER / CO-GENERATION PROJECTS (AS ON 30.11.2008)

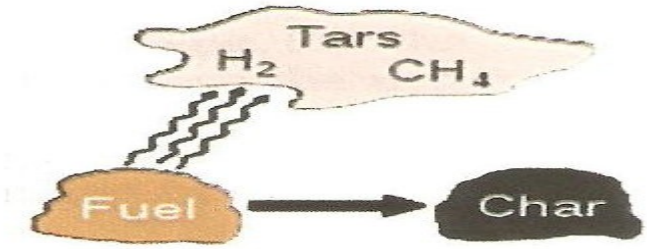
S.No.	State	upto 31.03.2003	2003-04	2004-05	2005-06	2006-07	2007-08	2008-0
1	Andhra Pradesh	160.05	37.70	69.50	12.00	22.00	33.00	9.00
2	Chattisgarh	11.00	--	--	16.50	85.80	33.50	9.88
3	Gujarat	0.50	--	--	--	--	--	--
4	Haryana	4.00	--	2.00	--	--	--	--
5	Karnataka	109.38	26.00	16.60	72.50	29.80	8.00	12.00
6	Madhya Pradesh	0.00	1.00	--	--	--	--	--
7	Maharashtra	24.50	--	11.50	--	40.00	38.50	41.50
8	Punjab	22.00	--	--	6.00	--	--	--
9	Rajasthan	0.00	7.80	--	7.50	8.00	--	8.00
10	Tamil Nadu	106.00	44.50	22.50	--	42.50	75.00	18.20
11	Uttar Pradesh	46.50	12.50	14.00	48.50	--	79.00	172.0(
	Total	**381.30**	**129.50**	**136.10**	**163.00**	**228.10**	**266.00**	**270.5(

The Biomass power/cogeneration programme is implemented with the objective of promoting technologies for optimum use of country's biomass resources for grid as well as off grid power generation. Biomass materials successfully use power generation including bagasse, rice, husk,

straw, cotton stalk, cotton stalk, soya husk, de-oiled cakes, coffee waste, jute wastes, groundnut shells, saw dust, saw chips etc. There are a number of technological options available to make use of a wide variety of biomass types as a renewable energy source. Conversion technologies may release the energy directly, in the form of heat or electricity, or may convert it to another form, such as liquid bio-fuel or combustible biogas. While for some classes of biomass resource there may be a number of usage options, for others there may be only one appropriate technology. The technologies which are being promoted include combustion/cogeneration or gasification either for power in captive or grid connected modes or for applications

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

Instead of combustion, it is possible to convert the biomass into producer gas by gasification (partial combustion). Thermo-chemical gasification involves burning the biomass with insufficient air so that complete combustion doesn’t occur, but a gaseous product is obtained. The producer gas is a mixture of carbon monoxide and hydrogen. Gasifiers are classified as updraft or downdraft depending on the direction of flow of the biomass and producer gas. India has significant experience in atmospheric gasifiers. The advantage of gasification is that using the synthesis gas is potentially more efficient than direct combustion of the original fuel because it can be combusted at higher temperatures or even in fuel cells. Synthesis gas may be burned directly in internal combustion engines, used to produce methanol and hydrogen, or are converted via the Fischer-Tropsch process into synthetic fuel



Pyrolysis of carbonaceous fuels

Gasification of char

In the process of pyrolysis carbonaceous material heats up. Volatiles are released and char is produced, resulting in up to 70% weight loss for coal. The process is dependent on the properties of the carbonaceous material and determines the structure and composition of the char, which will then undergo gasification reactions. The combustion process occurs as the volatile products and some of the char reacts with oxygen to form carbon dioxide and carbon monoxide, which provides heat for the subsequent gasification reactions. The gasification process occurs as the char reacts with carbon dioxide and steam to produce carbon monoxide and hydrogen. At these temperatures carbon monoxide reacts with steam (H2O) forming CO2 and H2. Hence there is a balance of concentrations of CO, CO2, H2O (Steam) and H2(Hydrogen).

Sugar industry has been traditionally practicing cogeneration by using bagasse as a fuel. With the advancement in the technology for generation and utilization of steam at high temperature and pressure, sugar industry can produce electricity and steam for their requirements. It can also produce significant surplus electricity for sales to the grid using same quantity of bagasse. For example, if steam generator temperature is raised from 400 Degrees C to 485 Degrees and pressure raised from 33 bar to 66 bar, more than 80 kwh of additional electricity can be produced for each ton of sugarcane crushed. The sale of surplus power generated

through optimum cogeneration would help a sugar mill to improve its viability, apart from addition to the power generation capacity of the country.

(Article sourced from internet sites and green energy publications)
