

GENERATING CLEAN ENERGY FROM WASTE

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Some of the first generation technologies of animals dung (gobar) gas, ethanol from sugars and starch, bio-diesel production and power generation are not competitive due to market forces and availability of better alternative technologies. Latest Anaerobic Digestion technologies for crop residues have made Bio CNG cheaper than Fossil CNG. Anaerobic digestion of mixed feed stocks of paddy straw with cattle dung; industrial wastes and activated sewage sludge has further raised the productivity of CNG. CNG being neat and clean fuel with zero foot prints of green house gases have been suggested by National Green Tribunal and other honorable courts.

In India, about 234 million tonnes of surplus biomass with a potential of Rs. One lakh crores fossil fuel import replacement has been estimated. However, burning of crop residues, cow dung cakes, exhaust of vehicles, tractors, untreated sewage, residues of milk, meat, vegetable and fruit processing and methane liberation from cattle dung heaps pollute air and pollute environment. Some of the first generation technologies of animals dung (gobar) gas, ethanol from sugars and starch, bio-diesel production and power generation are not competitive due to market forces and availability of better alternative technologies. Mulching and incorporation of crop residues into soil, with heavy machinery liberates green house gases and is not being adopted by farmers in spite of heavy fines as it leads to a higher cost of cultivation. Controlled burning of biomass into steam boilers for electricity generation also liberates air polluting gases and farmers lose very valuable organic manures which ultimately deteriorates soil health. Tariff rates of generated electricity of Rs. 7.50 to 8.1 per unit is unviable as compared to Rs. 2.44 per unit of solar and wind power. Latest Anaerobic Digestion technologies for crop residues have made Bio CNG cheaper than Fossil CNG. Anaerobic digestion of mixed feed stocks

of paddy straw with cattle dung; industrial wastes and activated sewage sludge has further raised the productivity of CNG. One ton of rice straw generates 115 kg of CNG worth Rs.4600 @ Rs.40 per kg with a total potential of Rs. 8300 crores and market of the paddy straw. By-products of organic manures or slurry maintains soil health, its fertility, productivity and profitability of the distressed farmers. It has a total potential of Rs. 25,000 crores of market sales annually. Oil marketing companies have become stakeholders in the production and marketing of bio-CNG with private investments of Rs. 10,000 crores. It will also create employment in primary and secondary activities and additional income of the farmers. CNG being neat and clean fuel with zero foot prints of green house gases have been suggested by National Green Tribunal and other honorable courts.

As per the report of Steering Committee on Air Pollution and Health Related Issues of the MoH&FW (2015), air pollution and food are the top most health risks. India is a polluted country with 1.6 million pre-mature deaths and 49 million disability adjusted life years due to household and ambient air pollution. Burning of crops residues,



Waste to electricity plant

animal dung cakes, fossil fuels, solid wastes, untreated sewage, dust particles etc. are the major sources of pollution. Co-digestion or co-management of crops residues and other biomasses with animal dung, wastes of milk, meat, vegetable, fruit, sugarcane processing and activated sewage sludge etc. can generate bio-fuels, compost for maintaining soil health, reduce import bill etc. Crops residues, industrial and other wastes have vast potentials of creating market for the wastes, provide rural employment, enhance income of the farmers and reduce pollution. Budget 2018-19 envisages incentives for **"Waste to Wealth"** including **GOBAR-dhan** scheme for realizing Rs. One Lakh Crore economy focused on bio-CNG generation. This year's budget has also announced an incentive of Rs. 7000 crores for the public sector Oil Marketing companies including GAIL to set up CNG purchase and sale infrastructure. Indian Oil Company has also signed an MoU of Rs. 5000 cores with Punjab state and investors to planning to set up 400 plants in the rural sector. Punjab Government has also transferred *Panchayat* land to Petroleum Ministry for investing Rs. 600 crores for setting up Bio Refinery in Bathinda with feed stock of paddy and other crop residues.

First Generation Technologies: Khadi and Village Industries Commission is promoting bio gas production from animal dung for many decades but could not scale up to the competitive marketing. Similarly, coal production from biomass has been banned now under the Pollution Control Act. Bio-diesel plantations of *Jatropha*, *Jojoba*, Olive oil and other oil bearing trees especially on waste lands could not end up into success stories. Ethanol production also led to competition for the so vital food and nutrition securities under declining per capita availability of land, water and other resources. Technologies of solar and window energy with tariff

rates around Rs.2.44 per unit has made some of the first generation bio fuel and other technologies irrelevant. Still more efficient photo voltaic technologies are in the pipeline and electricity tariffs are going to fall further making some of other bio-fuel technologies non-competitive.

Green Revolution Technologies: Investments into technologies generation, inputs, extension, efficient marketing and mechanization have increased food production from 52 million tons in 1951-52 to 277.5 million tons in 2017-18 i.e. 5.3 times increase in 66 years. About 234 Mt of biomass of crops, sugarcane, horticulture and others is surplus for producing bio-energy worth Rs

one lakh crores. Now profitability of the farmers has declined due to technology fatigue, market distortions, over-exploitation of soil and ground water resources etc. and has led to indebtedness and distress in rural sector. It called upon diversification and utilizing bio mass raw material for



Biogas Plant

doubling income of the farmers. High productivity and cropping intensity of mono rice-wheat system has created environmental problems of burning the crops residues. Various technologies have been evolved to manage residues of crops, industrial wastes, municipal and sewage wastes. Shredding and mulching of crop stubbles for quick seeding of next crop with Happy Seeders (Happy Seeder is one of the unique technique which is used for sowing wheat without any burning of rice residue) requires a higher investment and subsidy of Rs.1151 crores for Punjab, Haryana, UP and Delhi for heavy machinery has been provided in the current budget. However, the farmers are apprehensive of the high cost of cultivation and are not adopting it in spite of imposing fines by the state governments as per the directions of National Green Tribunals and other honorable courts. It will also release green house gases during decomposition process. Diversification into production and processing of perishable

commodities of milk, meat, vegetable, fruits etc. also requires management of their wastes. Accordingly, incentives for "Waste to wealth" have been announced in the 2018-19 Budget to augment income, employment,



Bio gas Digester

clean and green environment in the rural sector by harnessing second generation (2G) advanced technologies of bio-fuels.

Second Generation (2G) Bio Fuel Technologies:

First generation technologies focused primarily on sugar, starch, plantations etc. and competed for limited land and other resources, environmental, food and nutritional security. 2G technologies aim at cost effective, import substitution and pollution free bio fuels production.

Crop residues as Fuel: Traditionally, a part of crop residue as cotton sticks etc. are used for cooking food. However, there are vast quantities of paddy and other straw but they have low calorific values. Most of them are loose bulky material, which require densification and bricketing for fueling the steam boilers for power generation. High alkalinity, silicon and low melting point of rice straw ash corrodes, klinkers, slags and fouls the boilers. Special grating and travelling type Franklin boilers are now available and are being used in Punjab for electricity generation. As compared to uncontrolled and incomplete burning by farmers in the field, there is a complete combustion in the boilers with relatively lesser air pollution potentials. It still releases green house gases except black smoke particles in the open burning. Moreover, tariff rates work out to be between Rs.7.5 to 8 /unit as compared to Rs.2.44 per unit in solar and wind power. It requires considerable subsidy for wheeling the electricity generated. This technology also does not produce any organic manure to maintain health of soil, its fertility, productivity and farmers profitability.

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Refineries: Punjab state has already transferred Panchayat land in Bathinda to The Ministry of Petroleum for setting up Rs. 600 crores plant for producing ethanol from paddy and other biomasses. However, this process generates

37% less energy as compared to Bio CNG.

Anaerobic Digestion Technology:

This resolves many limitations of thermal power generation. In fact, the first anaerobic digester for human excreta in the world was demonstrated in India in 1859 near Mumbai for lighting up a lepers colony set away from the city. However, anaerobic digestion of rice straw is more difficult as compared to excreta of animal and human beings. Rice straw is hollow, coated with a hard layer of lignin with relatively higher contents of carbon, celluloses and hemi-celluloses as compared to sugars, starches etc. used for ethanol production in the first generation technologies. The 2G technologies focus on Bio CNG generation ordered by the Supreme Court of India for public and other transport for improving air quality and pollution reduction. Patented and verified technology of anaerobic digestion of IITs, DBT, others and related policies are now available. After producing bio gas, the remaining residue (digestate) is a very good manure free from seeds of weeds and other harmful elements. One ton of paddy straw will give 250 cu.m. of bio gas or 115 kg of CNG worth about Rs.4600 @ Rs.40 per kg. Production of Bio CNG gas from 18 million tonnes of paddy straw alone being burnt amounts to sales of Rs.8300 cores and more than that of compost and liquid manure with a total business of Rs. 20,000 crores annually with almost zero pollution of air in Punjab state alone. It will also create primary and secondary level employment both for the skilled as well as unskilled persons. Indian Oil Corporation has already signed an MoU

in June 2017 for Rs.5000 crores with Punjab Govt. for setting up biogas and bio CNG gas plants. It will generate about 400 jobs around each plant. Indian Oil Corporation has further signed up with companies to set up 400 plants over next 3-4 years, all over the rural areas of Punjab. It will bring in private investment of Rs.10,000 crores in the rural sector.

Advanced Technology: Bio-gas needs further purification by removing carbon dioxide and Hydrogen sulphide for arriving at BIS standards compressed CNG for vehicular and other purposes. Advanced technologies are in the pipe line even to convert carbon dioxide to methane which has a relatively high calorific value and is better in quality in terms of environmental externalities as compared to imported fossil CNG. It will be cheaper than imported CNG by Rs.10-15 per kg and will survive even in competitive marketing.

Convergence, coordination, co-generation and co-placement: Rice straw with high carbon content is a difficult feed stock and mixing it with low carbon and relatively high nitrogen animal dung, food wastes, spoiled potatoes, activated sewage sludge, wastes of milk, meat, vegetables and fruit processing plants increases the overall productivity of both bio and methane gas. Mixing of rice straw and cattle dung in 80:20 ratio produces 70 per cent more as compared to rice straw alone. Some of the companies are purchasing fresh cow dung at Rs.500 per trolley at the bio-digester site, poultry dropping at Rs.40 per kg and spoiled potatoes at Rs.50 per quintal as feed stocks for

bio CNG production. All stinking dung heaps in the villages need to be replaced with digesters. It requires coordination of various departments of agriculture, horticulture, animal husbandry, dairy, sewage treatment and rural development to optimize complementarities and complementarities. It will lead to sustainably benign healthy India and generate employment, income, goods, services and pollution free environment.

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Mahila Kisan Shashaktikaran Pariyojana and Value Chain Initiatives

In order to promote agro-ecological practices that increase women farmers' income and reduce their input costs and risks, the Deendayal Antodaya Yojana – National Rural Livelihoods Mission (DAY-NRLM) has been implementing Mahila Kisan Shashaktikaran Pariyojana (MKSP). As of March 2018, more than 33 lakh women farmers were being supported under this scheme. Further, about 8 lakh Mahila Kisans have been mobilized into 86,000 Producer Groups (PGs) which are federated into 126 Producer Companies (PCs). These value chain development initiatives have contributed significantly to the farmers' income from agriculture, horticulture, dairying, fisheries and Non-Timber Forest Produce (NTFP) related activities. Small and marginal farmers producing Maize, Mango, Floriculture, Dairy, Goatery etc., have benefited significantly through the value chain interventions across different states. As on February 2018, more than 1.05 lakh SHG members have been covered under these interventions. In order to enhance agricultural productivity, the Mission promoted 4,150 Custom Hiring Centre/ Community Managed Tool Banks across multiple States. These hiring centers enable small and marginal farmers to hire farm equipment and services such as soil testing, cold chain management etc., at nominal rates.