Bagasse power in India: Meeting challenges of energy, environment and sustainable development

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Power from bagasse

India, which accounts for around 85% of South Asian electricity generation, is facing serious power problems with current generation is about 30% below demand. New options have to meet the challenge and need to invest heavily in new electric generating capacity. Overall, Indian power demand [1] is projected to increase to 1,192 billion-kilowatt hours (BkWh) in 2020, around three times the 378 BkWh consumed in 1996. India one of the leading sugarcane producers in the world realizing the potential of bagasse, a by-product of the sugar industry, for power generation, has come up with various programs and incentives to boost the sector.

India produces nearly 40 million metric tonne (MMT) of bagasse, which is mostly used as a captive boiler fuel other than its minor use as a raw material in the paper industry. Sugar mills in the country especially in the private sector have invested in advanced cogeneration systems by employing high-pressure boilers and condensing cum extraction turbines. These sugar mills have been able to export power in the season as well as in the off-season by using bagasse or any other locally available biomass and to some extent coal. Off-season operation has been more lucrative by exporting power which otherwise earlier was non-existent except some operation and maintenance work. High technology has made these sugar mills efficient by improving the economic viability of the mills in terms of higher production of units of electricity per unit of bagasse.

The following shows the data on cogeneration of various sugar mills.

Fuel consumption and power production data of some sugar mills (1999-2000)

Sugar mills ? **Description** ?	**EID Parry**	**Thiru Aroonan**	**Shamanur Sugars**
Installed capacity (MW)	24.50	18.00	22.00
Gross energy generation (mu): S	124.74	65.52	49.75
Gross energy generation (mu): OS	26.39	35.34	0.0
Power export (mu): S	76.18	35.86	33.70
Power export (mu): OS	21.46	29.49	0.0
Operating days: S	249	213	167
Operating days: OS	65	125	0
Average plant load factor (%): S	85.20	71.21	56.42
Average plant load factor (%): OS	69.05	65.44	--
Fuel used (MT) – in-house bagasse	324319	151574	87748
Fuel used (MT) – bought-out bagasse	100700	49872	24972
Fuel used (MT) – other biomass	6738	682	0
Fuel used (MT) – fossil fuel	0	23224	0

Note:- S: season; OS: off-season; mu: million units; MT: metric tonne

The configuration below for a 5000 TCD sugar mill shows the status of equipment before and after the cogeneration project.

Before cogeneration:

Boilers 2x18 tph, 11.25 kg/cm^2, 225 ^{0}C; 2x29.45 tph, 14 kg/cm^2, 250 ^{0}C, 1x50 tph, 15 kg/cm^2, 250 ^{0}C
Turbines 1x2 MW, 13 kg/cm^2, 250 ^{0}C back pressure turbine; 1x1.5 MW, 13 kg/cm^2, 250 ^{0}C back pressure turbine; 1x2 MW, 13 kg/cm^2, 250 ^{0}C back pressure turbine

After cogeneration:
Boilers 2x70 tph, 66 kg/cm^2, 485
Turbines 1x30 MW, 64 kg/cm^2, 485 ^{0}C double extraction cum condensing

With the initiative of Ministry of Non-conventional Energy Sources (MNES) and the Greenhouse Gas Pollution Prevention – Alternative Bagasse Cogeneration (GEP-ABC) project of United States Agency for International Development (USAID), much needed awareness has been created. However, greater coordinated efforts are required for the co-operative sugar mills to go for cogeneration projects. A lead Program Partnership Initiative (PPI) has been launched by MNES. Under this initiative Maharashtra Industrial Technical Consultancy Services Ltd. (MITCON) has identified about 50 projects aggregating about 500 MW spread over nine major sugar-producing states. Sustained measures to ensure coordination and follow-up with the Ministry, Financial Institutions, State Agencies/Electricity Boards on the one hand, and with promoters and sugar mills on the other, are being undertaken by the program partners. Under the national program MNES has extended capital subsidies for cogeneration projects in cooperative/public sector sugar mills through joint venture companies (JVCs) set up by state governments or independent power producers.

Environmental benefits
The sugar mills showing interest in cogeneration projects, it has benefited the environment by reducing the greenhouse gases (GHGs) in the atmosphere in terms of the usage of biomass as fuel. Bagasse and other biomass, which are renewable, can play a major role in substituting fossil fuel for future power generation. There is a potential of 3500 MW bagasse based cogeneration potential and 16500 MW other biomass power potential in the country. A typical 2500 TCD sugar mill having a cogeneration potential of 22 MW exports nearly 0.3 million units of electricity in the season with a gross generating capacity of more than 150 million kWhs in a year and thus can offset nearly 0.166 million tonne of carbon dioxide.

The Clean Development Mechanism (CDM) of the Kyoto Protocol can be an effective tool in the sugar sector creating a major impact by the way of technological and financial transfer between India and developed countries and can help start the transition towards truly environmentally, economically and socially sustainable energy systems. The carbon credits generated in the process would also create an additional market for these environment friendly technologies.

Moreover, ethanol – another product of the sugar industry by its use in the transport sector can also play a critical role in reducing GHGs. Ethanol can be used as a 10% gasoline blend in the automobiles without any modification to the engines. It can also be used as a diesel blend in stationery engines and automobiles along with an additive. India consumes nearly 6000 billion liters of gasoline and 42000 billion liters of diesel. Ethanol, which is currently, produced from molasses has the capacity to substitute more than 1000 million liters of gasoline per annum. To meet additional demand of ethanol other methods such as direct production from cane juice and bagasse can be explored.

Means to sustainable development
In the past, the sugar industry depending on sugar alone for its commercial viability can now opt for an integrated production facility by opting for power and ethanol. New sugar mills have shown interest to first implement the cogeneration project and then the sugar production, however, more than 90% of the sugar mills in the country are yet to enter the power sector. Exported power to the grid not only improves the commercial viability of the sugar mill but also helps in voltage stabilization of the local grid. There is some progress on the use of ethanol in the transport sector, at least the government has initiated some pilot testing, and the policy will follow on the basis of the results. The overall impacts of sugarcane and its products on economy, environment, and rural development with local benefits thus can provide the linkage to sustainable development.

References:
[1]. Background paper, Energy Summit 2000, November 29- December 2, 2000, Chennai.