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Research Paper Economics

Efficiency Assessment Of Cogeneration in Indian Sugar Industry

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ABSTRACT

India, with a total population of about 920 million, faces a peak electric generating shortage of over 20% and an energy shortage of 12%. Cogeneration, the combined generation of steam and electricity, is an efficient and cost-effective means to save energy and reduce pollution. Many studies around the world have identified sugar mill cogeneration as an attractive low-cost option to place additional generating capacity on the grid. The Central Electricity Authority forecasts that India will need a total generating capacity of about 386,000 MWe by 2020. There are 400 to 500 mills currently in operation in India. Many Indian sugar mills have recognized the potential for the profitable generation of excess power via cogeneration. The sugar industry alone has been estimated to have the potential for 1500-4000 MWe, with most estimates around 3500 MWe. The private sector must increase its participation in the development of all viable generating options within India because the capital requirements necessary to meet the country's power sector goals are beyond the government's capabilities. With its large coal reserves, India will continue to rely on conventional coal-based power generation technologies to meet most of the country's future power generation needs. However, nonconventional power sources, such as biomass, wind, and solar, are expected to provide small, but regionally important contributions, to the country's power supply. This study assess the efficiency of power extracted via cogeneration and its environmental benefits.

KEYWORDS : Cogeneration, Bagasse, Sugar Mills

INTRODUCTION

India, with a total population of about 920 million, faces a peak electric generating shortage of over 20% and an energy shortage of 12%. It has a burgeoning middle class population driving its future with regard to power generation and the environment. Cogeneration, the combined generation of steam and electricity, is an efficient and cost-effective means to save energy and reduce pollution. Many studies around the world have identified sugar mill cogeneration as an attractive low-cost option to place additional generating capacity on the grid. India is the world s largest producer of sugar. The rapidly changing markets provide an excellent opportunity to develop innovative methods to optimize the cogenerated power from the sugar plants to reduce the energy shortage faced by the country. Most studies estimate the cogeneration potential of India's sugar industry at around 3500 MW_e . Despite significant investments by the government, the gap between peak demand and supply in India for all forms of energy, including electricity, has increased and is likely to widen further in the near future. Regional power shortages have been much high as 34% . The Central Electricity Authority forecasts that India will need a total generating capacity of about 386,000 MW_e by 2020. The private sector must increase its participation in the development of all viable generating options within India because the capital requirements necessary to meet the country's power sector goals are beyond the government's capabilities. With its large coal reserves, India will continue to rely on conventional coal-based power generation technologies to meet most of the country's future power generation needs. However, nonconventional power sources, such as biomass, wind, and solar, are expected to provide small, but regionally important contributions, to the country's power supply.

SUGAR MILL COGENERATION IN INDIA

Energy system sequentially generating electrical power and thermal energy and System common in cane sugar industry for a very long time. Co-generation is the combined production of two forms of useful energy from the same fuel. The advantages of sugar mill cogeneration include relatively low capital cost requirements and the use of a renewable, indigenous waste as a "non-polluting" fuel. Furthermore, the number and size of Indian sugar mills are sufficient to make a measurable contribution to local power supplies. India has been estimated to have a total industrial cogeneration potential of about 18,000 MW_e . The sugar industry alone has been estimated to have the potential for 1500-4000 MW_e, with most estimates around 3500 MW_e.

The principal fuel used to raise steam in sugar mills all over the world is bagasse. So is in India too. The gross heating value of mill-wet bagasse is approximately 2300 kcal/kg. Depending on the technology deployed, and the corresponding efficiency, about 75-90% of the bagasse available at Indian mills is used to produce internal steam and electricity; the balance is considered surplus and is either discarded or used for other purposes. The availability of surplus bagasse, or other fuels, is a major issue when considering year-round cogeneration with power export to the grid. There are 400 to 500 mills currently in operation in India. Many Indian sugar mills have recognized the potential for the profitable generation of excess power via cogeneration. Also, many of the State Electricity Boards are looking to the sugar mills as economical power sources to meet the growing national demand. Thus, sugar mills have started looking at alternative schemes to increase power generation.

Table 1: General Data of a typical Sugar Mill in India

Parameter	Value
Mill Capacity, TPD	5,000
Cane Crushed, mt/yr	707,771
Crop Duration, days/yr	204
Average Cane Crushing Rate, TPD	4244
Downtime, % of Milling Season	15.33
Fiber, % of Cane	14.6
Bagasse, % of Cane	32.8
Moisture, % of Bagasse	52.32
Bagasse Produced, mt	224,326
Bagasse Sold to Pulp Manufacturers, mt/yr	13,324

ISSUES ON COGENERATION IN INDIA

The recent study of Indian sugar mills evaluated the general ability of Indian industry to supply the equipment and instrumentation needed to produce surplus steam and power within the mill via cogeneration such that power can be exported to the grid . Cogeneration with power export is pursued in the larger mills, with larger turbines. The conventional turbine technology deployed in Indian sugar mills have relatively poor conversion efficiencies in the range of 55 to 65%. Moreover, with only a few steam turbine manufacturers in the country, the mills have to contend with long lead times for delivery and generally unsatisfactory levels of performance and service. Also, the indigenous industry is not fully ready to supply and service all of the equipment and instrumentation necessary for reliable, efficient cogeneration. Other issues

that need to be resolved between potential industrial cogenerators and the utilities include utility apprehensions regarding the reliability and availability of privately generated power, and grid synchronization and securing adequate fuel supplies for year-round cogeneration.

Table2: Comparison of Current with RFP (Request for proposal) and Proposed Cogeneration Schemes

Parameter	Current	RFP Requirements	Proposed
Capacity, TPD	2500-6000	2500	2500-7000
Pressure, ata	14-21	60	62-87
Temperature, ° C	320-340	430	480-510
Operation, day/yr	180-210	270	270-310
Steam Consumption, % on cane	50	NS	NA
Power Generation, MW_e	3-8	NS	15-50
Capital Investment, $/kW	0	NS	371-886

Note: NS - Not Specified; NA - Not Available

Regarding the Environmental Benefit, power export to grid during season (172 days)will be 41.28 GWh; power export to grid during off season (100 days)will be 36 GWh; total power exported in one year, 77.28 GWh; emission reduction, 62950.75 tonnes/y; and annual revenue at Rs 270 / tonne of CO_2 reduction, Rs 1.7 crores.

CONCLUSIONS

Cogeneration in sugar mill (2500 TCD) study provides that electricity generation capacity can be increased from 3 MW to 15 MW. Thereby the plant can export nearly 41 million units of electricity in the season (172 days) and nearly 36 million units of electricity in the off-season (100 days). India's power needs over 300,000 MW_e power in next 25 years. Cogeneration, the combined generation of steam and electricity, is an efficient and cost-effective means to save energy and reduce pollution. Many studies around the world have identified sugar mill cogeneration as an attractive low-cost option to generate power. Most studies estimate the cogeneration potential of India's sugar industry at around 3500 MW_e . Progress in the Indian sugar industry should pave the way for cogeneration projects in other industrial sectors, such as paper, chemicals, and textiles. Contributions from these sectors are important if India is to meet its huge power generation needs.

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