Sweet Power

Sugar mill waste is a cleaner source of energy.

Text by DEEPANJALI KAKATI
Photographs by HEMANT BHATNAGAR

The green fields and the lingering sweet smell are the sensory highs of sugarcane country. But what is equally exciting is the concept of a sugar mill using its waste products to generate electricity, a process called cogeneration. The potential in India for heat and electricity produced from sugar mill waste is about 3,500 megawatts (MWs), according to the Ministry of Non-conventional Energy Sources.

Though existing capacities generate only 600 MWs, substituting biomass materials for "dirty and expensive fossil fuels, like diesel and heavy oil, lowers greenhouse gas emissions and improves India's energy security in the long run by reducing the country's dependence on costly imported petroleum," says Glenn Whaley, director, Office of Environment, Energy and Enterprise at the United States Agency for International Development, or USAID.

Until a few years ago the concept of cogeneration may have seemed an impossible idea. But it is now a reality in sugar mills across the country, one of which is Rana Sugars in Butter Seviyan, Amritsar district. It is one of nine mills that have received financial and technical assistance from USAID to set up cogeneration units and generate power for 270 days a year.

Most sugar mills burn coal or oil to generate power to run their machinery. But the mills that have received assistance from USAID have taken the eco-friendly route. During the sugar-making process all the juice is squeezed out of the sugarcane and what is left over is a dry, fibrous substance called bagasse. The bagasse would normally have been disposed of as waste. But

Rana Sugars Ltd. in Butter Seviyan, Amritsar district.

these mills use it to produce electricity and steam. Sugar and cogeneration plants, in fact, depend on each other. The sugar factory provides fuel, i.e., bagasse, from milling the cane. This fuel is fed into boilers and the steam generated is channeled into turbines to generate power. The extracted steam is then supplied to the sugar factory, where it is used for boiling juice and distillery processes. "No part of the sugarcane goes to waste. After the bagasse is burned, the ash is dumped in the fields, where it acts as manure," says Gurbax Singh, in charge of production at Rana Sugars.

With a monthly realization of Rs. 24 million from the sale of power to the Punjab State Electricity Board in 2004-05, Rana Sugars is a good example of how profitable eco-friendly power generation can be. In 2002-03 the total revenue of the nine mills from power export was around Rs. 1.1 billion. "We are now encouraged to set up more biomass turbines," says P.S. Bhatti, chief accounts officer at Rana Sugars.

USAID's initiative dates to the 1990s, when it conducted workshops in different parts of India to assess the interest in high efficiency cogeneration. Encouraged by the enthusiastic response of the sugar mills, USAID formulated the Alternative Bagasse Cogeneration (ABC) component of its Greenhouse Gas Pollution Prevention Project in 1995. The project is USAID's largest climate change initiative worldwide. The objective of the ABC component, which was met in 2003, was to reduce the emission of greenhouse gases by encouraging increased and efficient use of waste as a fuel or energy source at sugar cogeneration units. It started with a target of five private mills and was later expanded to nine, selected on a competitive basis and provided

financial aid of $7.2 million through the Industrial Development Bank of India. The U.S. Department of Energy's National Energy Technology Laboratory provided assistance for training, outreach and performance evaluation through Winrock International India, a nonprofit organization, and Science Applications International Corporation, an American research and engineering firm.

Located in Tamil Nadu, Punjab, Karnataka, Uttar Pradesh and Andhra Pradesh, all these cogeneration units are running successfully. These mills had invested about Rs. 5 billion in their projects, confirming the potential of high-efficiency cogeneration. The total installed cogeneration capacity in these projects is approximately 200 MWs and they have all entered into power purchase agreements with electricity boards in their respective states. These mills are exporting an estimated 500 million kilowatts per hour (KWH) of electricity, offsetting 550,000 tons of greenhouse gas emissions annually. According to USAID, the amount of greenhouse gas emission offset at a particular mill can be easily verified because the amount of cane crushed, bagasse produced, electricity generated and exported to grid are all documented.

Sugar mill cogeneration units in India usually use low temperature, low-pressure boiler-turbine configurations which have low electricity generation efficiency per kilogram of bagasse burned. Since the mid-1990s, USAID and the Ministry of Non-conventional Energy Sources have been promoting the use of high temperature, high-pressure configurations which would generate more power for each kilogram of bagasse burned. "Earlier sugar mills were generating 30 to 40 KWH per ton of cane. USAID's ABC component demonstrated 90 to 160 KWH per ton of cane," says P.R.K. Sobhanbabu, senior program officer in the energy and environment division at Winrock International India.

There are multiple benefits of cogeneration. Burning bagasse to generate thermal energy is beneficial for the environment as this energy would have otherwise been produced from greenhouse gas-producing fossil fuel. "When you burn fossil fuel you are releasing carbon dioxide that was trapped millions of years ago. But when you are using biomass you are releasing carbon dioxide that was absorbed by the crop while growing through a process called photosynthesis. So we are not adding anymore carbon dioxide to the environment. It is the ultimate in terms of recycling," says John Smith-Sreen, deputy director, Office of Environment, Energy and Enterprise at USAID.

Cogeneration units can provide electricity to nearby areas, minimizing power outages and reducing transmission and distribution losses. "Being a…locally available fuel, bagasse can make a tremendous contribution to enhancing the country's energy security," says Ram V. Tyagarajan, chairman and managing director of Thiru Arooran Sugars Ltd., one of the grantees based in Tamil Nadu. Besides, sugarcane farmers find a ready buyer for their produce, and other mills that do not have cogeneration units have a market for the bagasse they produce. Sugar mills, in fact, are India's second largest agro-processing industry, after cotton textiles, providing employment to more than 500,000 people in rural areas. There are other benefits for the local population, as well. "We are using our own resources to engage experts to help farmers increase productivity," says Bhatti. Sagar Sugars in Andhra Pradesh is supporting research on better types of sugarcane, while Thiru Arooran Sugars Ltd. is working to promote infrastructure development, increase cane productivity and encourage farmers through training in the latest agronomical practices and arranging for crop insurance.

The process, however, has a number of constraints. Tyagarajan identifies "frequent changes in power purchase policy" as one of the problems. Also, the price of bagasse has increased substantially over the past year or two. "We have to depend on our own bagasse. The production of sugarcane in Punjab and Uttar Pradesh was less than normal this season because of climatic conditions. Also, people prefer to cultivate wheat and paddy," says Bhatti. Rana Sugars, for example, runs its plant from November to April and therefore generates power for only six months. "If we have enough biomass the plant can run for eight to nine months," says Santokh Singh, chief engineer at Rana Sugars.

Problems notwithstanding, this sector has much potential. Besides the environmental benefits, "the increased earnings from bagasse cogeneration have enabled sugar mills to pay more remunerative prices to farmers and that, too, on time, with consequent improvement in the fortunes of sugarcane farmers and the rural economy as a whole," says Tyagarajan. □

From top left: Sugarcane is sent for crushing; the juice is squeezed out of the cane; and goes through multiple stages of straining; the dry powdery residue of sugarcane, bagasse, is collected; it is then burned to produce steam, which is used to run turbines; the control panel for the power turbines; the electricity generated is then exported to the grid.