Nishant Bioenergy Consultancy Limited, India 2005

the Ashden Awards for sustainable energy

School cookstoves running on crop waste in North India

Summary

Nishant Bioenergy, a small business in Chandigarh, has developed the Sanjha Chulha (combined stove) - a large stove for institutional-scale cooking, which uses briquettes made from crop waste as fuel. Each stove can provide meals for up to 650 people, and thirteen stoves are now in use in residential schools in India, with more on order.

India has many schools and other institutions which provide meals for large numbers of people. Liquified Petroleum Gas (LPG) is widely used for cooking, and is currently subsidised by the Government. However this subsidy is due to be phased out over the next five years and the world price of oil is rising, so the cost of cooking is set to increase.

Crop waste which cannot be used for animal fodder is often burned in the fields, in order to allow a second crop to be planted quickly. India has considerable expertise in compressing this waste into briquettes which can be used as fuel, and there are many commercial briquetting plants in operation. The main market for briquettes is brickmaking: however demand is variable and the price which brickmakers are willing to pay is low because the alternative is cheap coal.

Briquettes are cheaper than LPG for cooking, and the Sanjha Chulha thus solves two problems - it allows schools to use a cheaper, sustainable fuel, and provides the briquetting industry with a more regular and higher-price market. Because schools are unable to afford the initial capital cost, Nishant Bioenergy provides finance which they can repay within 18 to 24 months from their savings in fuel bills.

The Ashden judges were impressed with the commitment and ability of Ramesh Nibhoria, who has built up Nishant Bioenergy from scratch. He has developed a stove which brings multiple benefits, and a financing package which makes it affordable. Cooks like to use it and their institutions save money. Greenhouse gas emissions and local pollution are reduced. The fuel supply chain brings secure income to briquette-makers and the small farmers who supply them with crop waste. There is great potential for replicating this technology throughout India and elsewhere.

The organisation

Nishant Bioenergy is a small business, set up by Ramesh Nibhoria in 1999. He had previously worked for a briquetting consultancy. He currently employs seven other people.

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Technology and use

The Sanjha Chulha
The Sanjha Chulha (combined stove) is a massive, robust appliance, which is permanently installed in the kitchen. It is designed for use throughout the day, and sized to provide full meals for up to 650 people. At one end of the stove the briquettes are fed by hand into the combustion chamber, at a rate of about 15kg per hour: this can easily be varied to suit the cooking needs. The combustion chamber is made from firebricks, with a cast iron grate. Ash collects in a trap under the grate and can be removed when necessary. Insulation around the firebricks minimises heat loss and keeps the outside of the stove, made from mild steel, at a safe temperature. The hot combustion gases flow under hotplates, designed to provide uniform heat over the base of two large (250 litre) cooking pots. The hotplates can also be used for making chapattis, which are familiar home food and very popular in boarding schools. The exhaust gases flow out of a chimney through the roof of the kitchen. A 400 litre water tank around the chimney absorbs heat from the exhaust gases, and provides water at up to 90oC for cooking and making tea. Care has been taken to provide a good working environment for the cooks: the hotplates are at a comfortable height, an electric light is provided, and the chimney and an exhaust hood over the stove keep smoke away.

The flow of gases through the stove is controlled by three small (120 W) electric fans, which initially provide both the primary air to get the briquettes burning, and the secondary air to burn the volatile gases which are driven off the solids. This enables the stove to burn cleanly and efficiently within a few minutes of being lit - which is usually the worst time for pollution. The air inlet pipes run through the path of the exit (flue) gases, and thus extract heat which would otherwise be wasted. After about ten minutes, two of the fans cut out. The remaining fan maintains an air flow through the stove, and also through the exhaust hood, when cooking is in progress. The stove still works if there is an electric power cut, but with lower efficiency.

Briquetting
Briquetting of agricultural and forestry residues is a well-established industry in India. Residues such as mustard stalks, coffee husks, groundnut shell, sugar cane trash, cotton stalks and sawdust are collected, air-dried and ground up. Electric power is used to compress the powdered residue, and then extrude it through a tapering die into a long, cylindrical rod about 50 mm in diameter, which is broken into 100 mm long briquettes. The high pressure (around 120 MPa), combined with frictional heating in the die, causes natural lignin to ooze out of the cells of the residue. Lignin acts as a glue, so that the briquettes are firmly bound and can be handled without crumbling. India currently has over 200 briquetting plants, each producing around 250 tonnes of briquettes per month. The potential supply of residues is much greater than this, and more briquettes could be produced if the demand was higher.

How users pay

Users pay Nishant Bioenergy for the full cost of the stove which is about 136,000 rupees, (£1,700) and pay the briquette suppliers for the fuel. The main problem for schools is to find the initial capital for the stove. Many residential schools in India are providing education to poor students: they do not have large capital budgets and they are not allowed to take out bank loans. Nishant therefore provides credit, so that users pay in instalments from the savings which they make in their fuel costs.

A typical example is a residential school catering three meals per day for 450 people, which previously used 3 cylinders (42.6 kg) of LPG each day. With current Government subsidies, the LPG costs 900 rupees (£11) per day or 27,000 rupees per month. With the Sanjha Chulha, the school needs 150 kg of briquettes each day, costing 375 rupees (£4.70) per day or 11,000 per month. From the monthly savings of 16,000 rupees, Nishant Bioenergy takes 15 payments of 10,000 rupees (£125) to cover the cost of the stove. These payments will be collected over a period of about 18 months, to allow for school holidays.

Training and support

Staff from Nishant Bioenergy install each stove and provide three days training for users. During this training period the amount of briquettes which are used is monitored, so that the monthly cost of running the stove can be estimated and compared with the previous cost of LPG. This gives users the confidence that the monthly payments are affordable. Nishant offers a maintenance contract for 7,500 rupees (£94) per year, and the stoves installed to date have worked very reliably.

Benefits of the project

Schools like the stoves. They save money, and have a secure fuel supply. The savings will become more significant as the price of oil increases and the government subsidies are reduced. Cooks find the stoves convenient to operate, they can use them for different types of cooking and the food tastes good! Teachers have noted that children from rural backgrounds really understand the benefits of using biomass waste.

Briquetting plants earn typically 40% more from selling briquettes to schools than to industrial users, and have a guaranteed market. Production of one tonne of briquettes needs about one day of labour, so supplying six schools would generate an extra full-time job. The benefits go along the supply chain. Farmers are paid about 500 rupees (£6) per tonne for field waste, and a typical smallholding of 2 hectares (5 acres) produces about 5 tonnes of waste per year, which brings in the equivalent of an extra month's income to the farm

Using briquettes instead of LPG gives both local and global environmental benefits. The residues used are not suitable for fodder or compost, and would normally be burned in the field to allow a second crop to be planted. This gives significant local pollution and risk of fire spreading. There are some concerns about using agricultural residues in domestic-scale stoves, because they tend to produce more particulates and gaseous pollutants than wood or LPG, particularly if they are lit and extinguished several times during a day. However, the design of the combustion air supply and the exhaust system of the Sanja Chulha produce efficient, clean combustion. A Sanja Chulha which avoids the use of 42.6 kg of LPG per day, offsets 26 tonnes of CO_2 equivalent per year. The use of electricity for briquetting the residue and running the fans produces only about 1 tonne of CO_2, so the net annual saving is an impressive 25 tonnes of CO_2 equivalent per stove.

Currently there is a subsidy of 135 rupees per cylinder of LPG, thus the government saves about £1,600 (130,000 rupees) in subsidy for every stove installed.

There is enormous potential for replicating this work, throughout India and in many other countries. There is a plentiful supply of field waste to make briquettes, and many large institutions which need to provide cooked meals. The stove could also be adapted for small-scale industries such as soap-making and dyeing.

As with many applications of biomass, the challenge is to match fuel supply with demand. India already has an infrastructure for supplying briquettes which could meet the initial demand from institutional stoves. Ramesh Nibhoria would like to franchise the technology and business model of the Sanja Chulha under licence to manufacturers in other parts of India.

Management, finance and partnerships

The production, installation and financing of the Sanjha Chulha is all undertaken by Nishant Bioenergy.

The research and development was supported by a Government Grant for Technopreneurs, and private finance from Ramesh Nibhoria. The initial trial stove was installed in a boarding school run by Navodaya Vidyalaya Samiti, a Government organisation which provides free education to able students from poor backgrounds in residential schools throughout India. They were very satisfied

with the trial, and were the first customers for the Sanjha Chulha when it went into commercial production in July 2003.

Use of the Ashden Award

Nishant had been successful in the sale of their biomass-burning stove, but wanted to increase their capacity and expand the areas in which they sold the stove. Since the Award, the number of installed stoves has increased from 10 to 23, with a further 8 currently under construction. In addition to this Nishant has held high-level meetings with the Indian government, resulting in a deal to install 150 stoves in a chain of schools.

To cope with the increased demand for their stoves, Nishant has taken several steps:

- Increased workshop capacity through the purchase of new machine and hand tools.
- Hired two new employees for sales and office support.
- Made technological improvements to the stoves to increase their durability, including replacing mild steel components with stainless steel and redesigning the fire grate.
- Two independent agents have been appointed to carry out the installation and maintenance of stoves produced by Nishant.

This report is based on information provided to the Ashden Awards judges by Nishant Bioenergy; findings from a two-day visit by one of the Ashden judges to see their work in India; and presentations by Ramesh Nibhoria at Ashden Awards seminars in London.

Dr Anne Wheldon, Technical Director of the Ashden Awards, November 2005.