

# Towards Cleaner Technologies



A process story on biomass gasifiers for heat applications in small and micro enterprises

# FOREWORD

India annually produces about 400 million tonnes of a variety of biomass, which on a tonnage basis is on a scale comparable with coal production. Most of these biomass materials are consumed for heat generation, as has been the practice since the dawn of human history.

The single largest use of biomass in India is for cooking and other household purposes. Besides, there are over one million SMiEs (small and micro enterprises) that burn biomass fuels. However, unlike coal, which is used with conversion efficiencies of over 80% in boilers and other equipment, the conversion efficiency with biomass is still quite low at about 10%. The result is a huge wastage of an important natural resource. Also, biomass combustion in traditional devices produces smoke, carbon monoxide, and other health-damaging emissions. It is thus imperative to use the available biomass resources more efficiently and in a clean manner. Gasification technology offers considerable scope for achieving this goal.

Biomass gasification as a technology emerged during the Industrial Revolution, and was successfully used for running automobiles, lighting public places, cooking in urban households, and generating power during the Second World War, largely in European countries. It re-emerged in the wake of the oil crisis in the 1970s in India and in a few other developing countries such as the Philippines; the technology's main application at that stage was seen in small-scale power generation for purposes such as irrigation pumping. In recent years, however, interest has been rekindled in biomass gasification, particularly among developing countries that are rich in biomass resources and that find themselves caught between rising prices of fossil fuels on the one hand and development needs on the other.

TERI began to work in the field of gasification in 1984 in a small way at its Field Research Unit at Pondicherry, and later organized and expanded its

activities in Delhi. A gasifier demonstration unit was set up on a lawn in the capital's posh Jorbagh area; a car garage served as a small workshop; and an attached bathroom was converted into a fuel-testing lab! With initial help from MNRE (Ministry of New and Renewable Energy), research and field activities were implemented in the village of Dhanawas in Haryana.

A number of exploratory activities were undertaken to introduce the technology as a fuelwood-saving measure in plantations (such as for cardamom curing, tea drying, and so on), and as a replacement for furnace oil used in boilers in small industries (herb-based products, tobacco processing, etc.). It was apparent that, besides applications in small power-generating systems, judicious use of biomass gasification technology could result in fuelwood savings – with implications of reduced deforestation – as well as savings in furnace oil/diesel/LPG (liquefied petroleum gas)—with implications of increased energy security.

During the same period, SDC (Swiss Agency for Development and Cooperation) was active in the sericulture sector. SDC was supporting efforts by the government to improve mulberry farming and cocoon rearing practices, and was also helping in the promotion of an improved silk reeling oven. Silk reeling units operated with very low profit margins and consumed huge quantities of fuelwood, and SDC was keen on exploring the possibility of using energy-efficient technology to reduce fuelwood consumption and increase the profitability of silk reeling units. Given their commonality of interests, it was natural for SDC and TERI to join hands in developing energy-efficient gasifier-based systems for the silk reeling industry.

Similarly, from the early 1990s, SDC was actively supporting efforts to bring about rural development in Sikkim—a state where the cultivation and processing of large cardamom is a major economic activity. The curing of large cardamom consumes huge amounts of firewood, and TERI's experience in developing efficient methods of cardamom curing in southern India again made it natural for the two organizations to work together in developing a wood gasifier for large cardamom curing in Sikkim.

These two early joint initiatives by SDC and TERI greatly helped in solving issues related to the introduction and integration of a modern technology such as gasification with traditional sectors such as silk reeling and cardamom curing. Besides helping in the maturing of gasifier technology for heat applications, a methodology was evolved to mobilize the efforts of several actors such as reelers, industrial design experts, and silk experts through competence pooling. These two interventions helped TERI in widening the scope of installing gasifiers for a number of other

applications—ranging from sweet-making to steel re-rolling, chemical processing to community cooking, crematoria to crumb rubber drying. TERI's interactions with entrepreneurs, manufacturers, government officials, NGOs, and others have helped in creating awareness about the potential benefits offered by biomass gasification in all kinds of other SMiE applications.

Today, there are eight manufacturers licensed and trained by TERI to make gasifiers, and over 350 gasifier systems for diverse applications have been installed in the field in different parts of the country with a cumulative capacity of over 14 MW<sub>th</sub> (megawatts thermal). These achievements have been possible thanks to the support extended by SDC and the great flexibility it has shown in the course of TERI's work.

A very important lesson TERI has learned is that to promote gasifier technology among traditional, resource-poor SMiEs, it is essential to forge bonds of trust and cooperation with the owners. This requires extensive and sustained work with NGOs and other community-level organizations. In other words, the technological efforts have to be accompanied by efforts aimed at techno-social integration or TSI. TERI is pursuing this strategy in its ongoing work with 'puffed rice' makers in Karnataka. TERI also recognizes the importance of building bridges of cooperation with governmental institutions, particularly in SMiE areas such as sericulture where state-owned bodies exercise considerable influence on technologies as well as markets.

In today's rapidly globalizing economy, the SMiE sector must constantly overcome new challenges – in terms of better technology, higher operational efficiency, increased profitability, improved product quality – in order to survive. To build upon the wealth of experience gained during the past decade, in 2005 TERI and SDC launched an initiative titled CoSMiLE (Competence Network for Small and Micro Learning Enterprises). CoSMiLE brings the various interventions by SDC and TERI in the SMiE sector under a common umbrella. In essence, CoSMiLE is a dynamic and informal network, comprising players bound together by a keenness to learn and share knowledge in order to bring about technological improvement and socio-economic development in the SMiE sector. In the years to come, efforts will be made through CoSMiLE to encourage widespread adoption of clean, energy-efficient technologies such as biomass gasifiers and thereby bring socio-economic benefits to those who depend on SMiEs for their livelihood.

**R K Pachauri**  
Director-General, TERI