Energy Policy 39 (2011) 7543–7556

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Improved stoves in India: A study of sustainable business models

Gireesh Shrimali [a,*], Xander Slaski [b], Mark C. Thurber [b], Hisham Zerriffi [c]

[a] Department of Information Systems and Center for Emerging Markets Solutions, Indian School of Business, Hyderabad 500032, India
[b] Program on Energy and Sustainable Development, Stanford University, Stanford, CA 94305, USA
[c] Liu Institute for Global Issues, University of British Columbia, Vancouver, British Columbia, Canada

ARTICLE INFO

Article history:
Received 15 December 2010
Accepted 14 July 2011
Available online 17 August 2011

Keywords:
Improved stoves
Business models
Social enterprise

ABSTRACT

Burning of biomass for cooking is associated with health problems and climate change impacts. Many previous efforts to disseminate improved stoves – primarily by governments and NGOs – have not been successful. Based on interviews with 12 organizations selling improved biomass stoves, we assess the results to date and future prospects of commercial stove operations in India. Specifically, we consider how the ability of these businesses to achieve scale and become self-sustaining has been influenced by six elements of their respective business models: design, customers targeted, financing, marketing, channel strategy, and organizational characteristics. The two companies with the most stoves in the field shared in common generous enterprise financing, a sophisticated approach to developing a sales channel, and many person-years of management experience in marketing and operations. And yet the financial sustainability of improved stove sales to households remains far from assured. The only company in our sample with demonstrated profitability is a family-owned business selling to commercial rather than household customers. The stove sales leader is itself now turning to the commercial segment to maintain flagging cash flow, casting doubt on the likelihood of large positive impacts on health from sales to households in the near term.

1. Introduction

Burning of biomass in traditional stoves is associated with a host of ills among the estimated 2.5 billion people around the world that do not have access to modern fuels (IEA, 2009). Indoor air pollution (IAP) from traditional biomass burning contributes to serious health problems, particularly cancer and respiratory infections that cause an estimated 1.6 million premature deaths annually (Naeher et al., 2007; Smith, 2006; WHO, 2006). The time required for biomass collection can preclude formal employment outside the household for women, and the cost of purchasing biomass can weigh heavily on household budgets where formal biomass markets exist (Ramani and Heijndermans, 2003). Moreover, a growing body of literature suggests that incomplete combustion products and black carbon from traditional biomass burning have a significant contribution to climate change (Johnson et al., 2009; Smith et al., 2000).

Technologies are reasonably well-established for "improved cookstoves" that burn biomass more cleanly and efficiently, and could thus help mitigate the above problems (Hulscher, 1998; Masera et al., 2007). However, after more than 25 years of effort, largely by governments and NGOs, less than a third of the total biomass-using population – an estimated 166 million households encompassing about 828 million people – has adopted an improved stove (UNDP/WHO, 2009).[1] The Chinese National Improved Stove Program (NISP) has been the lone cookstove dissemination effort to achieve broad success at scale, distributing approximately 130 million stoves, most of which remained in use over a long period of time (Smith et al., 1993; Barnes et al., 1994; Sinton et al., 2004). The Indian National Program on Improved Chulhas (NPIC), on the other hand, is often seen as emblematic of the kinds of things that can go wrong with government-run cookstove initiatives.[2] NPIC was criticized for poor stove design, high program cost, and low uptake rates; by heavily subsidizing stoves, it also undermined pre-existing local markets for stoves (Barnes et al., 1993).

NGOs have not had much luck either. Despite more than 25 years of effort, NGO efforts remain small-scale (Barnes et al., 1994). Numerous problems, including fragmentation of effort and

[1] The WHO and UNDP estimate that there remain 116 million improved stoves in the field in China, 13 million in East Asia, 20 million in South Asia, 7 million in Sub-Saharan Africa, and over 8 million in Latin America and the Caribbean (UNDP/WHO, 2009). It is unclear what fraction of households possessing improved stoves actually uses them on a regular basis.

[2] It ultimately distributed 32 million stoves in the period 1983–2000, and a 1995–1996 survey showed that perhaps 60% of stoves distributed to that point were still in use (Sinha, 2002). This number has likely declined significantly since then, given the lack of government support and the ultimate withdrawal of the program.

* Corresponding author.
E-mail address: gireesh_shrimali@isb.edu (G. Shrimali).

0301-4215/$ - see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.enpol.2011.07.031

insufficient attention to scalability and sustainability, have prevented such operations from expanding to serve a larger customer base (Edwards and Hulme, 1992; Uvin et al., 2000). Overall, NGOs have not made a significant impact in increasing access to improved stoves; the vast majority of stoves now in use were distributed by government programs—particularly the Chinese and Indian programs (Barnes et al., 1994).

The poor track records of government and strictly charitable efforts at large-scale and sustained diffusion of improved cookstoves have contributed to an increased focus on complementary commercial and market-driven solutions. In fact, the most successful stove program to date, China's NISP, combined a central push with locally coordinated efforts to create functioning markets for stoves. Similarly, the Kenya Ceramic Jiko (KCJ) charcoal stove is an example of an improved cookstove that has seen wide distribution on a commercial basis, with approximately 2 million stoves in use as of 2002 (Ministry of Energy, 2002). The KCJ was originally developed with substantial NGO funding in the early 1980s but over time has made the leap to commercial sustainability (Hyman, 1986, 1987; Bailis et al., 2009; Kammen, 2001).

The emphasis on commercially sustainable solutions also reflects a broader shift in the conventional wisdom on how to improve the welfare of the poor, with donors focusing on catalyzing markets rather than providing indefinite support (Bailis et al., 2009). In this context, a hybrid model of a "social enterprise", which attempts to blend a commercial approach in operations with relaxed requirements on returns in order to fulfill a social need, is increasingly being used (Borzaga and Defourny, 2001). Though the exact definition of a "social enterprise" is often left vague, commercial or semi-commercial operations offer the potential in theory of being both more scalable and more sustainable than fully subsidized efforts because they develop viable supply chains and customer-responsive business models rather than relying on centralized distribution mechanisms and ongoing funding support.

Recently, organizations aiming to sell cookstoves commercially have emerged around the world, with operations in Latin America, Africa, South Asia, and the Asia Pacific region. However, there are few demonstrations thus far of self-sustaining commercial distribution of improved stoves, and there is a need to assess what would make commercial cookstove programs successful. As part of a larger study directed toward this need, this paper focuses on commercial cookstove companies in India, given that India has been a focal area for commercial cookstove operations. Reasons include its large population centers, relatively supportive and stable policy environment, comparatively well-developed infrastructure, and rapid economic growth. In particular, India offers a large potential market for improved stoves—approximately 75–100 million households (Venkataraman et al., 2010).[3] An assessment of commercial approaches in India is especially timely as the Indian government considers various approaches for its newest biomass cookstove initiative (Venkataraman et al., 2010).

Several fledgling efforts now exist to serve the Indian market on a commercial basis. The two companies that have achieved the largest market penetration had sold approximately 450,000 and 120,000 stoves, at the time of the June 2010 interviews on which this paper is primarily based.[4] The goal of this paper is to perform an initial assessment of the progress of these and other commercial stove distribution efforts in India in order to extract broader insights into the conditions under which commercial business models for cookstove distribution might be able to overcome the obstacles to cookstove diffusion.

We note that few of the efforts in India are at a sufficiently advanced stage to conclusively evaluate their performance. However, many of them have been in operation for long enough that their experiences thus far offer preliminary indications of the key factors that affect the ability both to achieve scale in improved stove sales and to be self-sustaining.[5]

2. Background and hypotheses

Prahalad (2004) popularized the theory that commercial enterprises can profitably serve those at the "bottom of the pyramid". However, improved stoves have several characteristics that may make them uniquely challenging products to sell to the poor (Slaski and Thurber, 2009). First, with typical prices in the range of $20–$85,[6] they are expensive, especially for populations that are truly at the bottom of the pyramid—those earning less than $2 per day, or about 2.6 billion people globally (World Development Report, 2007/2008). To illustrate this point, Table 1 compares the consumer affordability hurdle for four different interventions that can improve the health or welfare of low-income populations in the developing world. Second, the switch to new fuels and cooking technologies may be complicated by cultural and societal norms related to cooking (Eberhard, 1993). Many stove programs have failed because their designers failed to deeply understand user preferences and cooking patterns (Barnes et al., 1993; Crewe, 1997). In fact, one advantage the KCJ stove might have had was that it only represented an incremental modification to traditional stoves in Kenya (Hyman, 1987). Third, and most importantly, many users have simply failed to sufficiently value the advantages of the improved stoves on offer to spend scarce money on these stoves or to discard traditional cooking methods. Health or time benefits that seem compelling to outside observers may not be observed or prioritized by the potential users themselves (Barnes et al., 1994; Jin et al., 2005; Baris and Ezzati, 2007; Howells et al., 2010).[7]

The existing literature on diffusion of cookstoves and other products targeting the poor offers insights into how the above obstacles might be overcome in commercially oriented stove distribution models. Many of these insights are not unique to commercially oriented stove distribution models and apply to government distribution programs as well.

First, the literature suggests that stove technology and design choices are very important, including the strategy for how and where to manufacture the stove. In particular, the quality of the stoves is very important as evidenced by the poor adoption of NPIC stoves, which were of low quality (Barnes et al., 1993).

[3] Of India's population of nearly 1.2 billion, more than half live in rural areas, where biomass use is most common. 71% of the Indian population does not have access to modern fuels, although in rural areas the percentage of the population without access to modern fuels rises to 90%. Worldwide, 27% of those reliant on solid fuel live in India, but only 9% of the Indian population reliant on solid fuels has access to an improved stove, leaving a large remaining market (UNDP/WHO, 2009).

[4] The company with 120,000 stoves in the field as of June 2010 had reached the 200,000 customer mark a year later.

[5] We use "self-sustaining" in an expansive way in this paper—not precluding, for example, the incorporation of government subsidies into a business model if these subsidies are judged to be sustainable over a reasonably long period (at least 3–5 years).

[6] For consistency purposes, we have converted all price and cost numbers to US dollar equivalents, using appropriate conversion factors. For example, we have used a 47-to-1 conversion ratio (the exchange rate on June 9, 2010) between the Indian Rupee and the US$.

[7] For example, stoves can be contrasted with malaria nets, where 99% of those surveyed cited at least one advantage for a child under five to sleep under a net, whereas only 3% named a disadvantage (NetMark, 2003).