Ashden India
Renewable Energy Collective

SHAKTI
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Briefing Paper Series on Decentralized Renewable Energy for Sustainable Energy Access

Clean Cooking Energy for All: Renewed Thinking in Five Key Areas

An estimated 75% of rural Indian households continue to use firewood and agricultural residue, dung cake, and coal/charcoal as cooking fuels. The use of these fuels in traditional cookstoves is neither clean nor efficient, and due to the high levels of indoor air pollution resulting from incomplete combustion and inadequate ventilation, it poses a significant health risk, particularly to women and children. For many decades, the provision of clean cooking energy has been recognized by the Government of India as a development imperative. However, efforts to replace traditional cookstoves continue to meet with limited success.

Recent developments

Provision of clean cooking energy in India is a mammoth challenge, but several recent trends are notable.

- Past efforts in provision of clean cooking energy have been largely government-led, but there is recent exploration of the social enterprise model. Examples are found in lighting and other community development areas.
- Social and private enterprises are exploring both domestic and commercial cooking energy needs, and are seeking to integrate these end-uses with industrial thermal applications. The challenge, however, is that each application – domestic cooking, commercial/community cooking, and thermal industrial energy – has unique features.
- The business-to-business model is emerging, whereby cookstove manufacturers work with social enterprises for distribution of improved cookstoves rather than directly with users.
- Many agencies now recommend developing a range of stoves to meet various cooking needs and at various levels of affordability.
- Research is continuing on efficiency and emission improvements of processed biomass such as pellets and biogas.
- The quality and performance of cookstoves is critical, and work continues in testing and the development of standards. But many issues still require resolution.
- The black carbon (soot) associated with incomplete combustion of biomass in traditional cookstoves makes clean cooking energy an important climate change mitigation measure. This issue displaces deforestation, which was an early driver for development of efficient stoves. Drivers are important, as they play a role in determining alternatives and how those alternatives are evaluated.

Going forward, the Collective has identified five key interconnected issues:

1. Technology choice and product design
2. Delivery mechanisms and market development
3. End-user affordability and financing
4. Processed fuel management
5. Renewed policy stance

Technology choice and product design: One size does not fit all

To date, much of the focus in government efforts has been on improved (clean) biomass cookstoves (chulhas). Improved stoves are unquestionably important, but consultation with stakeholders reveals the need to broaden the discussion to fuels

>> Highlights

- Social enterprises and market-based mechanisms are struggling to address the critical issues of affordability and user preferences.
- One type of fuel, technology, and device does not fit all. Cookstoves and solar lamps don't pose the same challenges.
- Processed biomass fuels are deemed essential, but concerted efforts are needed to organise quality feedstocks at the right place at the right price.
- Government support is still needed to reach the poorest households in the most remote locations.

This briefing paper series has been conceptualised and prepared by the Ashden India Renewable Energy Collective (AIREC) with support from the Shakti Sustainable Energy Foundation. AIREC is a not-for-profit company set up by a group of India-based winners of the Ashden Awards for Sustainable Energy. Shakti Sustainable Energy Foundation works to strengthen the energy security of the country by aiding the design and implementation of policies that encourage energy efficiency as well as renewable energy. For more information, please visit <www.shaktifoundation.in>

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and energy sources other than biomass. These include LPG, piped gas, kerosene (wick and pressure type stoves), coal and charcoal, biogas, solar cookers, and electric induction stoves. Yet it can be assumed that biomass-based fuels and devices are likely to dominate the cooking energy solutions for rural communities in India, making the continued emphasis on improved and locally acceptable biomass cooking solutions imperative.

At the same time, unlike LPG and biogas stoves where a universal gas burner design seems to be acceptable in households across the country, the biomass cookstove needs to be tailored to local cooking practices and fuel availability. Consultation with experts is needed to better understand the numerous factors involved in decision-making applied to cooking energy fuels and devices. These factors include stove cost, dietary and cooking habits, type and cost of biomass fuel available, general living conditions, especially the type of housing and kitchen, and other priorities/expectations from cook stoves.[1]

Recognizing the need to find ways to integrate multiple objectives into cooking energy planning, the Collective is now partnering with leading practitioners, product developers, and researchers to devise a holistic tool for evaluation of clean cooking energy technologies and devices. Such a system will go beyond technical facets like combustion efficiency and emissions to factor in the expressed concerns of the household cook. Community priorities are likely to vary across locations and might complement or conflict with national/global priorities.

To accurately assess relative cost effectiveness, practitioners highlight the need to determine the cost per unit of thermal energy delivered by various options. It is therefore important to assess the energy intensity of each system (energy input–output ratio). It is also critical to make the assessments under local conditions, not in laboratory settings that are often at variance with ground realities in terms of cooking practices, vessels used, and type of food cooked.

Delivery mechanisms and market development: why solar lanterns worked but improved cookstoves didn't

Consultations with stakeholders in the clean cooking energy sector have provided important lessons for the future in terms of markets and last-mile delivery of services. These lessons appear to be generally consistent with observations about solar home lighting systems (SHS) that now have a reasonably large presence in India. There are, however, two important differences between SHS and cooking energy solutions. Cooking energy solutions are more diverse than SHS, and the fuel is always free for SHS, whereas most cooking technologies (with the exception of solar thermal/solar cookers) require fuels that may be freely available or available with effort or cost.

Parallels and lessons can still be drawn, particularly with regard to maintenance, and payment and finance mechanisms to address affordability gaps, inter-linkages between small, local, private-sector and NGO efforts, and country-wide government programmes. A selection of key lessons follows.

- Distribution of free cooking energy devices has not yet succeeded, and it remains important to assess and account for consumer ability and willingness to pay.
- Transaction costs are high for solar lanterns and cookstoves, both markets being dispersed and often remote. However, margins are lower (just 5%–10%) in the case of advanced cookstoves compared to solar lanterns, where margins can reportedly go over 20%. Discussions with entrepreneurs suggest that major enterprises with large overheads will find it challenging to succeed in the cookstoves business. Small enterprises with lower costs and a better understanding of the local context appear to be more viable than large firms.
- There is no universal model for device manufacturing. LPG cookstoves are available in most kitchen equipment stores. Biogas plants are largely constructed onsite, although some ready-to-assemble systems are now available. Improved cookstoves can be constructed onsite or purchased offsite. There are pros and cons to each option and these need to be studied based on the local situation.
- Forced draft stoves with blowers are increasingly available, but there is little discussion about electricity access or battery replacement systems that these stoves require. Similarly, solar lanterns have reportedly suffered from lack of attention to battery replacement, another important lesson for the cookstove sector.
- It will be important to engage local youth in servicing cooking energy technologies. As these will not be full-time engagements, it is advantageous to integrate them with relevant tradesmen such as masons.
- Finally, we need to recognize that in cooking applications, more than in any other energy subsector, gender plays an important role. The views

[1] The diverse uses to which the traditional cookstoves are put include space heating, water heating, and generating smoke to drive away mosquitoes. Interestingly, the stove is also viewed as a source of 'power' in the household – the lady who decides which stove to acquire is seen as powerful.

and voices of women, who have larger cooking roles than men in most parts of the country, are vital when devising any cooking system improvement. Without women in decision-making roles, cooking energy is unlikely to become a priority issue. Households may prioritise mobile phones and solar lanterns over improved cookstoves.

Small, scattered, diverse financing needs: a challenge

A significant challenge to the adoption of improved cooking fuels and devices is cost and affordability. Financing gaps need to be bridged but end-users are typically scattered and individual financing needs are too small to attract lenders. The technology and supply chains for cooking energy devices and fuels are also diverse and complex.

Nevertheless, there are examples of organizations working proactively with financing agencies in the cookstove arena. For example, Sustaintech India Pvt. Ltd (SIPL) has consumer finance partners such as Shri Kshetra Dharmasthala Rural Development Project (SKDRDP) who allow consumers flexibility in their purchase of SIPL's fuel-efficient commercial cookstoves. Greenway Grameen Infra is another example. It manufactures improved domestic stoves and has a relationship with Micro Energy Credits, which facilitates microfinance lending for clean energy devices.

However, a financial impediment remains. Whereas replacing kerosene with solar lighting produces immediate operating cost savings, the no cost or low cost of biomass fuel precludes such tangible savings. In such a situation it would be a challenge to convince banks or microfinance institutions to enter this market. Furthermore, the primary rationale for switching to clean cooking solutions is for health and environmental benefits. If these benefits can be systematically estimated and communicated, the inertia for change resulting from the absence of immediate financial savings from the switch to clean cooking energy can be addressed.

Some suggestions in response to the financing challenge include:

- The business correspondent model[2] facilitates the use of local community-based organisations for disbursal of small credits and it could be used as the mechanism for providing financing for clean cooking devices for households.
- Direct transfers of subsidies, particularly kerosene subsidies, could be treated as concessional loans or grants for clean energy solutions.

Processed biomass fuels for cooking: supply chain management challenges

It is now clear that improved efficiency of bioenergy-based cooking technologies will involve the use of prepared fuel. Processed biomass appears to be emerging as an important element of clean cooking energy, without women in decision-making roles. Processed biomass (briquettes, pellets, biochar, biogas, bio-CNG (or compressed biogas), where there is adequate waste with appropriate moisture content, will be an integral part of the clean cooking energy solution in rural areas. Current discussions do not dwell on the issue of processed fuel in any great detail, but the quantity and timely supply of quality fuel in the form of processed or prepared biomass will be a challenge. Key aspects of this challenge include the following:

- Arranging feedstock for biogas plants, and processing biomass into chips and pellets for improved cookstoves, will require institutional arrangements for cultivation or collection, storage, processing, and transport. The organisation of prepared biomass fuels may also need customisation by region, given differences in biomass type, mechanisms for collection, procurement, institutional contexts, and so forth. Whether these institutional arrangements must be centralised or decentralised remains uncertain. While decentralised approaches involving local communities in biomass fuel processing and related activities could generate livelihood opportunities, the reliability of these systems must also be assessed.
- Pricing the feedstock will likely be a sensitive issue because users are accustomed to gathering fuels free of cost. It remains to be seen whether consumers will be willing and able to pay for processed fuels.
- It must also be seen whether costs of processed fuels and of arrangements for forced draft should be capitalised and included in stove costs to make them more realistic for purposes of business plans and disbursement of subsidies.
- There are policy issues around pricing of pellets and briquettes needing

[2] Under the 'business correspondent' model, NGOs and microfinance institutions established under the Societies/Trust Acts, Societies registered under Mutually Aided Cooperative Societies Acts or the Cooperative Societies Acts of States, section 25 companies, registered NBFCs not accepting public deposits, and post offices may act as business correspondents. The scope of activities to be undertaken by the business correspondents will include: (i) disbursal of small value credit, (ii) recovery of principal and collection of interest, (iii) collection of small value deposits, (iv) sale of micro insurance and mutual fund products, pension products, and other third-party products, and (v) receipt and delivery of small value remittances/other payment instruments.

careful review. It is also important to not lose sight of the possible negative consequences of large-scale biomass monetisation. (Please refer to discussions on both of these topics in other papers in this series.)

- Standards of quality, reliability, and availability for biomass fuels are another critical gap.

Policy must be supportive but cognizant of user needs

In 2009, the Ministry of New and Renewable Energy (MNRE) launched a National Biomass Cookstoves Initiative (NBCI) aimed at the '…design and development of the most efficient, cost-effective, durable, and easy to use device.' It is commendable that the government recognizes criteria other than efficiency, which has hitherto been the only measure for an improved cookstove. Nonetheless, end-users have varied expectations for their cooking solution. It is difficult, and perhaps impossible, to identify a handful of stoves that can meet the aspirations of some 12 crore biomass-using households.

The government is planning to pilot clean-cooking projects, but these must be undertaken in a systematic manner. They must include various categories of cooking appliance needs, and reflect priorities determined by geography, culture, and cooking practices. It is suggested that pilot projects cover various agricultural and ecological zones with dissimilar cooking habits and biomass fuel availability.

The role of centralised policy-making in mainstreaming cooking energy solutions must be reviewed. The involvement of subnational agencies at the state and district levels should also be explored. State nodal agencies and regional rural banks may be involved, with clearly specified roles and deliverables.

The need to expand testing protocols for cookstoves is clear. However, it is important to recognise that stove performance in the rural household (field environment) deviates considerably from that in the laboratory. Variances include ambient conditions, ventilation, feedstock type, vessels used, and other issues pertaining to cooking practices. Therefore, while the Bureau of Indian Standards (BIS) protocols are based on the water-boiling test, cooking and kitchen performance tests[3] are recommended. Practitioners highlight the importance of testing in controlled laboratory settings in the presence of experts, as well as the need to complete testing process within a stipulated timeframe of about 3–4 months. Standards must also prescribe a range with some flexibility so as to offer a variety of stoves that meet different cooking needs and suit different payment capacities. In addition, because processed biomass is an emerging part of the cookstove equation, there must be standards for biomass briquettes and pellets, and the basis for these standards should be transparent.

It is encouraging that there is now recognition that subsidy (or free distribution) is not the only intervention recommended for large-scale adoption of clean cooking solutions. At the same time, we acknowledge that support is still required. Market-based mechanisms are often put forward as a solution, but private enterprises that must cover their costs in the face of low margins and high transaction costs, invariably avoid the poorest households and most remote locations. Consequently, the state cannot avoid its necessary roles, but to date there is no systematic effort to synthesize clean cooking efforts across ministries. Doing so would optimise solutions in multiple locations, based on their specific characteristics and priorities.

Several practitioners argue that it is not necessary to link subsidies to the certification process, while others suggest that subsidies could be limited to certain models based on stated criteria. For example, subsidies could be available only for cooking solutions that are best suited to the poorest households.

In addition to the MNRE chulhas initiative, in 2009 the Ministry of Petroleum and Natural Gas launched the Rajiv Gandhi Gramin LPG Vitaran Yojana (RGGLVY) scheme, with a goal to expand LPG use in rural areas. The Ministry has also been promoting the deployment of smaller, more affordable cylinders (5 kg capacity). Unfortunately, unreliable supplies have hindered these efforts, particularly in remote locations in the northeast where transportation costs are very high.

Clean and efficient cooking initiatives need to expand beyond governmental programmes. Approaches must be developed to explore engagement of the government, complemented by social enterprise and private sector initiatives.

[3] The water boiling test (WBT) is a laboratory test to investigate the heat transfer and combustion efficiency of the stove. It evaluates stove performance while completing a standard task (boiling and simmering water) in a controlled environment. It is the easiest, quickest, and cheapest to conduct, but only reveals the technical performance of a stove, not necessarily what it can achieve in households.

The controlled cooking test (CCT) is a field test that measures stove performance relative to traditional cooking methods when a cook prepares a local meal. The CCT is designed to assess stove performance in a controlled setting using local fuels, pots, and practice. It reveals what is possible in households under ideal conditions, but not necessarily what is actually achieved by households during daily use.

The kitchen performance test (KPT) is a field test used to evaluate stove performance in local settings. It is designed to assess impacts on household fuel consumption. KPTs are typically conducted in the course of a dissemination effort, with participants cooking normally. Additional details on stove performance tests are available at <http://ehs.sph.berkeley.edu/hem/?page_id=38>.

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Critical issues and summary of next steps

Topic	Critical issues	Recommendations
Technology choice and design	One size does not fit all. A range of stoves need to be made available and evaluated in terms of not just their technical performance (fuel efficiency, emissions) but also factors critical to users (ability to control flame, low smoke, ease of use, less cumbersome fuel arrangements, low cost).	■ Study of various cooking energy solutions to examine not only technical efficiency but to also get community feedback, approval, and endorsement. ■ Devise a mechanism for evaluating cooking energy options on a matrix of community priorities and both micro and macro mandates.
Delivery mechanisms and market development	There are a variety of cooking technologies, products, and needs. The population served is large and profit margins are small. How should efficient delivery mechanism(s) be designed? What are the issues in commercialisation; what works and does not; costs and willingness and ability to pay? Costs of batteries and maintenance of blowers?	■ Set up multi-stakeholder consultations to facilitate comparative assessment of institutional infrastructure models. Issues include for manufacture, delivery, maintenance, service of parts of cooking energy solutions, inter-linked and differentiated roles for large companies, NGOs, and energy service companies at the village or village cluster level.
Processed biomass fuel management	Improved biomass-based cooking energy is expected to rely largely on processed biomass. There are challenges in identifying, procuring, processing, storing, and delivering biomass, while ensuring that communities get adequate, quality, and timely and affordable supplies of fuel.	■ Conduct integrated study of cooking energy needs, biomass availability, economic situations and institutional contexts in various locations. This will inform processed biomass fuel management strategies for various regions. It will include centralised vs. decentralised approaches based on various types, quantities of biomass required, consumer ability and willingness to pay, and community preparedness to organise required processes.
Financing	Extending small loans to a large number of users.	■ Detail the mechanisms and incentives required for involvement of banks in provision of concessional small loans for improved cooking solutions. ■ Assess the benefits of access to clean cookstoves and explore the monetisation of these benefits to demonstrate savings from switch to clean cooking.

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Critical issues and summary of next steps *(Continued)*

Topic	Critical issues	Recommendations
Working with government and policy	Community priorities are not always mainstreamed, efforts tend to be isolated, cooking energy is still not seen as a priority, benefits of clean cooking energy still not understood or valued fully.	■ Arrange meeting of MNRE with a group of women's representatives to flag user concerns. ■ Develop recommendations for the process of evaluation, testing, and certification of stoves (certify a large number of stoves, delink this from subsidies, subsidies may be given on a limited number of stoves, testing to be done on the ground and not in laboratories). ■ Make recommendations on pilot projects for clean cooktoves. Look beyond improved cookstoves, integrate fuel issues, numerous pilots needed covering many agro-ecological and economic categories, integrate the possibility of assessment and monetisation of benefits of clean cooking energy. ■ Raise the status of improved cooking in technology research and policy-making. ■ Review cooking energy subsidies in totality – LPG, cookstoves, other devices – in terms of the purpose, targeted beneficiaries, impacts.
Cross-cutting	Need for integration of local user priorities in policy-making, technology development, and project planning for clean cooking energy.	■ Develop decision support system at the level of an agro-ecological zone for use by policy makers, entrepreneurs, and financers. Ashden Collective could do pilots for two or three such zones to demonstrate the methodological framework and usefulness of such decision support systems.