5. Thermal Energy Services with CLEAN COOKSTOVES

Sustainable Thermal Energy Service Partnerships

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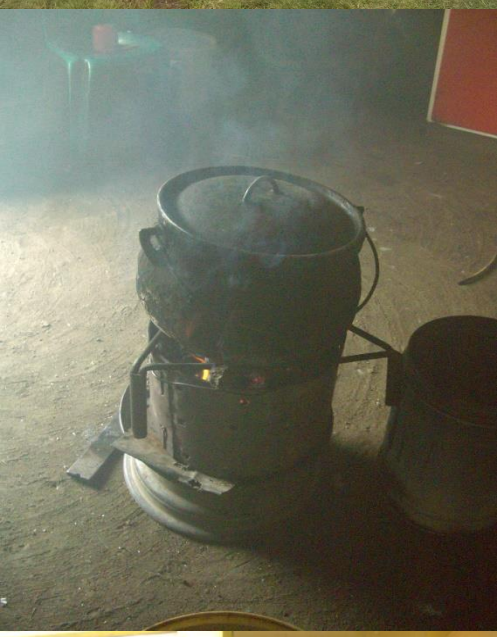
STEPs
Sustainable Thermal Energy Service Partnerships



FOREWORD

Clean cookstoves have the potential to improve the lives of some of the developing world's poorest people. With an impact on indoor air quality and public health, as well as aiding in environmental protection through preventing deforestation, the benefits of clean cookstoves can be wide-ranging.

The case studies presented in this document offer an insight into the success and failure modes of clean cookstove businesses. Ensuring a clean cook stove business will succeed starts at the very beginning, in targeting the right market with the right clean cookstove product. This can involve market research activities, assessing consumer opinions and determining the best options for the businesses operating context. Once a product/service option is determined however, a number of other challenges must be addressed. Financing and promotion (either direct or indirect) for clean cookstoves can also come from a policy-level, through direct or indirect subsidies, the promotion of private-sector operations in the microfinance sector, as well as a range of measures to create an enabling environment for new business, such as accreditation, licensing, training, marketing and education.

This paper gives an overview of the diverse issues surrounding clean cookstove businesses and business success, covering technology options for stoves and fuel choices, to market assessment and business development, accessing financing and financing models, public-private partnerships and gender issues.

- Xavier Lemaire & Daniel Kerr

Acronyms

ASCA – Accumulation of Savings and Credit Association

CEB – Ceylon Electricity Board

GACC – Global Alliance of Clean Cookstoves

GIZ – Deutsche Gesellschaft für Internationale Zusammenarbeit

GVEP – Global Village Energy Partnership

ICS – Improved Cookstoves

IRSAT - Institut de Recherche en sciences appliquées et technologies

KCJ – Kenya Ceramic Jiko

LPG – Liquefied Petroleum Gas

MFI – Micro-finance Institutions

NGO – Non-governmental Organisation

PPP – Public-Private Partnerships

SNV – Smart Development Works

UNEP – United Nations Environment Programme

USD – United States Dollar

VEC – Village Energy Committee

VESP – Village Energy Security Program

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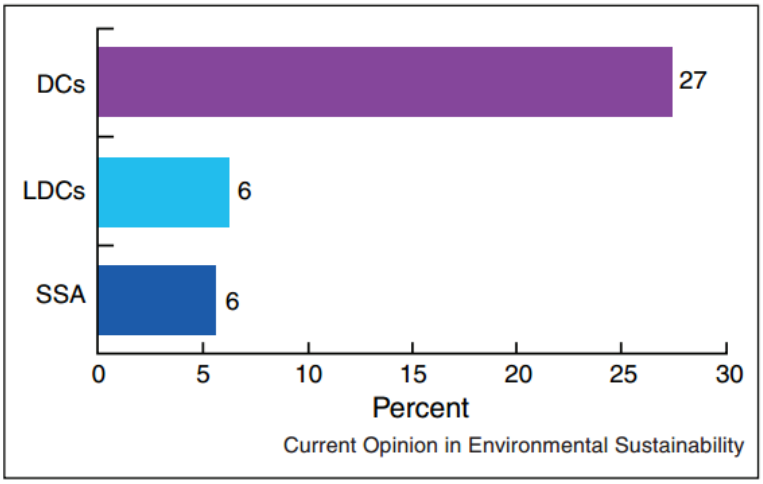
0. Introduction

Clean cookstoves have the potential to change the lives of the poorest people of the developing world, but only a small proportion of the population has access to improved cookstoves (figure 1 below). Through reducing the time burden of the collection of fuel and improving indoor air quality, clean cookstoves could significantly enhance the quality of life for consumer, and contribute to local economic growth.

This paper provide some recommendations for future business-focused growth in the sector. It investigate sustainable business models for cookstove products, and for clean cooking energy service companies.

Figure 1. Share of population using solid fuels with access to improved cookstoves in Developed Countries (DCs) Least Developed Countries (LDCs) and Sub-Saharan Africa (SSA)



Source: Bazilian et al. 2011.

1.0 Technology Options for Improved Cookstoves

Improved biomass stoves are generally run on similar principles to traditional stove designs, such as the three-stone stove. Improvements are made to its efficiency and cleanliness of burning through the use of improved biomass fuels firstly, and secondly through design principles. Insulation is a key factor and a recent improvement in stove technology, allowing higher heat levels to be retained for longer in the cooking vessel compared to old designs.

Clean cookstove technology options can be grouped through the type of fuel used by the cookstove. Improvements in the burning of traditional woodfuels are one option, as is using wood-derived fuels such as charcoal, either lumpwood or briquetted. Gel fuels derived from biomass, using ethanol as the main combustion fuel, have also grown in market share. Other options can include using Liquefied Petroleum Gas (LPG) as fuel.

Stove designs have also seen a diversification, and many differing designs are available on the market currently. These include a number of dominant designs from various geographical locations, such as the *Jiko* stove design from East Africa, and the *Chulha* stove design from South Asia, as well as more complex rocket stove designs from various locations. At its simplest, improved cookstove technology can take the form of a ceramic liner around the combustion chamber of a traditional wood stove, insulating the combustion chamber for higher efficiency through a lower heat loss to the surroundings.

Figure 2. Kenya Ceramic Jiko (KCJ) stove in Nairobi

Image: AIDG, Flickr, https://www.flickr.com/photos/aidg/533788023

Figure 3. Woman in India with Envirofit Chulha-design clean cookstove

Image: Envirofit, https://envirofit.org/field-notes-benefits-clean-cooking-bhor-india/

Figure 4. Oil-drum based rocket stove design for developing country applications on test in Oregon, United States

Image: Impact Hound, http://www.impacthound.com/energy-rocket-stoves-developing-countries/

Energy efficiency is not the only goal of clean cookstoves however, and stove designs have also strived for reducing emissions to the surroundings and cleaner burning. LPG stoves excel in this area, but designs for wood and charcoal stoves, as well as biofuel gel stoves, are improving combustion efficiency and reducing carbon dioxide, monoxide and particulate matter emissions, through enabling more efficient heat transfer and controlled production and venting of combustion by-products.

Improvements to LPG stoves, and to improved processed biomass fuel stoves such as pelletised woodfuels or improved charcoal, have also come in the form of cost reductions of the production of cookstoves. Realising these cost reductions can be through technology advances, or through changes in business structure. (Rai & McDonald,2009; Clough, 2012).

A factor affecting older clean cookstove designs has been longer cooking times than traditional stoves, and new designs help to alleviate that. Designs such as the *Kenya Ceramic Jiko*, a stove based off traditional cookstove designs but made more efficient through the addition of a heat-retaining ceramic liner, which have been in the market since the 1980s, typically display water-boiling times in controlled conditions of up to double that of more modern charcoal-burning designs.

Newer designs can often reach double the efficiency of these more established designs; for instance efficient rocket-stove technology, using woodfuel or charcoal, can reach up to 45% efficiency commonly, compared to 25-30% efficiency for ceramic-lined stove models. (http://catalog.cleancookstoves.org/test-results).

Table 1 below gives an overview of some common cookstove designs and their performance in standardised testing procedures defined by the *Global Alliance for Clean Cookstoves*.

Table 1. Comparison of Clean Cookstove Designs across Developing Countries through Global Alliance of Clean Cook stoves Testing Standards

Name of Cook stove	Country Cook stove Operated In	Fuel Type/Stove Type	IWA (International Workshop Agreement) High-Power Thermal Efficiency	Time to Boil (WBT 4.2.3 Protocol 5L Volume Test) – Cold Start (minutes)
CookClean CookMate	Ghana	Charcoal/Household Stove, Pot Skirt	25.7%	46.667
Apon Chulah	Bangladesh	Woodfuel/Rocket Stove	30.5% (WBT* 4.2.2)	26.0 (WBT* 4.2.2)
Traditional Bangladeshi Stove	Bangladesh	Woodfuel/Household, Traditional	11.0% (avg.)	34.0
LPG Stove Télia No. 2	Burkina Faso	LPG/Household Stove, Pot Skirt	49.2%	14.33
Canarumwe	Uganda	Wood/Built-in-Place, Traditional Ceramic	26.3%	No data
Prakti Single Burner Charcoal Stove	Democratic Republic of Congo	Charcoal/Household, Portable	33.1%	No data
SCODE SP-FL Micro-Gasifier (Portable)	Kenya	Woodfuel/Gasifier, Household	30.4%	23.0
New Lao Stove	Lao PDR	Charcoal/Ceramic-lined	23.8% (WBT* 4.1.2)	23.4 (Mean time to boil, WBT* 4.1.2)
Mwoto Quad2	Uganda	Woodfuel/Gasifier, Household, Heating	33.0% (WBT* 4.1.2)	19.1 (Temp-corrected cold start time)

*NB: WBT means Water boiling test

Table derived from http://catalog.cleancookstoves.org/test-results, with standards available online at http://cleancookstoves.org/technology-and-fuels/testing/protocols.html

2.0 Large-Scale Improved Cookstoves Markets

2.1 Kenya

The Kenyan clean cookstoves market is an example often used to define a successful, market-driven clean cookstoves sector (Kariuki & Rai 2010; Rai & McDonald, 2009; Shankar, Onyura & Alderman, 2015; Global Alliance for Clean Cookstoves/Dalberg, 2013a). Donor/development agency-led clean cookstoves programs in Kenya date back to the 1980s.

Figure 5. Kenya Ceramic Jiko (KCJ) stoves on sale in Kenya

Image: Analogue Digital, https://www.ctc-n.org/technologies/improved-cook-stoves

Kenyan Ceramic Jiko (KCJ), have become staple designs of the market. Traditional charcoal stoves however are still the predominant cookstove type used in Kenya, with estimates that almost half of the population use some form of charcoal stove, rising to 80% in urban areas such as Nairobi. The cookstove market is fragmented, with the majority of cookstove production done on a small to medium scale. Distribution costs can be high because of this, and with a poor road network in some areas, it becomes more interesting for wholesale buyers to collect directly from local producers. Cookstoves are sold through a combination of dedicated retailers and traditional vendors, with wholesale buyers acting as further distribution agents to demand centres. (GVEP International, 2012a).

The Kenyan cookstoves market is an example of one where producers have focused on cost reductions for clean cookstove manufacture, perceiving that low cost is the primary market driver. These measures include sourcing local materials at a lower cost/for free where possible (like clay), and manufacturing shorter-lifespan stove designs for a lower cost, possible with the dominant Jiko stove design in Kenya. Upfront costs of the *Kenya Ceramic Jiko* in Kenya is now average around USD7, compared to USD20 for an LPG or wood-fired rocket stove. However, these cost reductions have compromised the quality of the end product in cases analysed under the *Developing Energy Enterprise Program*, run by GVEP. Maintaining quality while increasing profits can be achieved through other, business-based measures such as diversification and accessing new markets.

Table 2. Common improved/clean cookstoves on the Kenya market as of 2017

Improved Solutions		Clean Cooking Solutions		
Legacy and Basic ICS	**Intermediate ICS**	**Advanced ICS**	**Modern Fuel stoves**	**Renewable Fuel Stoves**
Example: Kenya Ceramic Jiko, KuniMbili stove	*Example:*Ecozoom, Burn stove, Jikoupesi	*Example:*Gasifier	*Example:* LPG	*Example:* Biogas, ethanol gel stove
Key features: Small functional improvement over baseline technology; artisan produced	*Key features:* Rocket principal to enhance combustion efficiency; some with high end materials and good finishing	*Key features:* Fan jet or natural draft gasifier with very high combustion efficiency and reduced emission; often attain tier 3-4	*Key features:* Relies on fossil fuel or electricity; zero emission with very high efficiency	*Key features:* Derived from renewable non-woody fuel; some are supplement energy sources
What is included: • Basic efficient charcoal • Basic efficient wood	*What is included:* • Portable rocket • Fixed rocket chimney • Highly improved	*What is included:* • Fan gasifier • Char stove	*What is included:* • LPG • Electric cooker • Kerosene	*What is included:* • Biogas • Ethanol • Solar oven • Fireless cookers

Source: Kenya Climate Innovation Centre, 2017.

Mechanisation of the cookstove manufacturing process has also been trialled by a Kenyan cookstove business, *Fine Engineering*, producing the *Jiko Poa stove*. This approach has the potential to reduce costs but requires significantly more capital investment. (Clough, 2012; GVEP International, 2012a)

2.2 India

The potential market for clean cookstoves in India is vast. As of 2013, approximately 67% of households were still using some form of solid fuel (most traditional biomass fuels) for cooking, equivalent to around 166 million households. Estimates from the Global Alliance for Clean Cookstoves in 2013 suggest that the total household market for clean cookstoves is around 235 million households, including both easy-to-address and challenging market segments. Middle-to-high income solid fuel purchasers were estimated to make up around 14% of this market, and this income group could easily transition either to improved or clean cookstoves, or to other modern energy sources such as LPG. Around 45% of this market was estimated to be made up of rural solid fuel purchasers, however. Given the low overall levels of income in this market segment, innovative financing models and business models would be necessary to enhance affordability for this market segment to disseminate cookstoves on a private-sector basis. India has a burgeoning clean cookstove industry, however distribution challenges, and the affordability challenges, are hampering wider-scale adoption of clean cooking technology in the country. (Global Alliance for Clean Cookstoves/Dalberg, 2013b)

Efforts to support the dissemination of Improved Cookstoves (ICS) have existed in India since the 1930s but have been only sporadic without real political long-term commitment until recently. Various projects have tried to achieve scale with clean cookstoves in Indian states; one to be mentioned is the *Village Energy Security Program* (VESP) launched in 2004 and discontinued in 2012[1]. This programme adopted a multi-energy services integrated approach quite similar in a way to the STEPs model with a mix of electrification and thermal energy services. It sought to develop *Village Energy Committees* (VECs) which could run decentralised, village-level programs under the auspices of the VESP, to incorporate biomass gasifiers, biogas electricity plants and improved cookstoves into the targeted regions' energy mix. The program, however, experienced severe operational constraints, and more than half of the installations made during the program were non-operational at the end of it. In total, some 4,100 cookstoves were distributed under the program, along with 700kW of biogas electricity capacity, and 1,330 cubic metres of biogas digester capacity.

Constraints to the program were identified to be both economic and institutional: consumers' willingness to pay for electricity generated under the program was low, and personal investment in clean cooking technologies, including clean cookstoves, was also low, providing a disincentive to continue using the technology over previous cooking options. Empowerment and training was another area in which the program was lacking, and while development of women's cooperatives was strong, training and capacity-building for operating sustainable technologies, including clean cookstoves, was not provided to new users, causing system failures, and for clean cookstoves, contributing to the reversion to former cooking methods. (Palit et al., 2013)

[1] Previously, an important program was the *National Program for Improved Chulhas* (NPIC) which contributed to the dissemination of 35 million cookstoves from 1984 to 2002. This program is well described in Hanbar & Karve (2002).

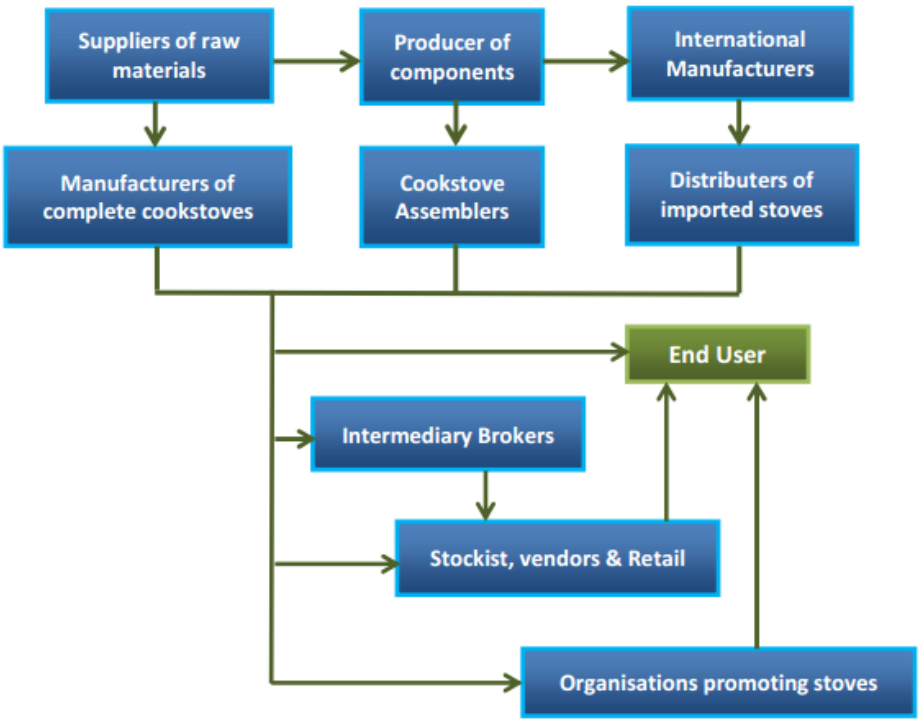
Efforts to support ICS have been more intense since the 2010s. Now even if numerous pilot projects have been launched in India notably under the *National Biomass Cookstoves Initiative* starting in 2009, the main focus and success of the government-encouraged initiatives seems to have been on LPG cookstoves (see section on LPG on STEPs website).

3.0 Organisation of the market

3.1 Integrated Value Chains for Clean Cookstoves

The clean cookstoves value chain can be defined as having production, distribution and sales components. Production of clean cookstoves can involve the production of components for further assembly, such as insulating liners or stove bodies, or the production of complete cookstoves for distribution and/or sale. Distribution of stoves can be a separate, transport-sector business, or can be conducted by the producing company. Sale of stoves can be separated from production and distribution, for example with distribution companies selling to private sole traders or companies. (Clough 2012)

Figure 6. Simplified value chain options for cookstove dissemination



Source: GVEP International, Clough 2012.

In markets such as Sri Lanka and Kenya, separate production and distribution/sales businesses have been most common, with the majority of stove bodies and liners being produced indigenously in areas with the best natural materials. Other markets, such as Uganda, India and to a lesser extent Tanzania, have operated on a more vertically-integrated basis, with one company having production, distribution and sales capabilities. (Rai & McDonald, 2009)

The integration of the value chain can offer advantages to a company: experiences in the Kenyan sector suggest that having a distributed, multi-stage value chains can impede market entry to new businesses and increase costs for established businesses. Having multiple participants in a value chain leads to multiple instances of margins being added for company profits, inflating the final cost to consumers, and also the costs to new market entrants in sectors further along the value chain, for example sales companies. Having an integrated business model, whilst requiring more initial capital and a more complex operational model, would avoid these issues. (Kariuki & Rai 2010; Global Alliance for Clean Cookstoves/Dalberg 2013a; Global Alliance for Clean Cookstoves, 2014)

3.2 Financing, Credit and Financing Models

There have been a number of financial models that have seen business and project success when used with ICS. The most common model for business seems to be a vendor sales model, with sole traders or companies buying in cookstoves from distribution companies or producers for resale. Whilst this is a simple model administratively, and has proven success, for example in the Kenyan market, there are limits to its ability to reach consumers in rural areas, or bottom-of-pyramid users who may lack the financial resources to directly purchase a cookstove.

There are successful examples of micro-credit business models being used to enable greater reach and scale of cookstove businesses, as well as in donor/government-funded projects. These include the SELCO solar lighting business in India[2], integrating microfinance, offering improved biomass cookstoves to their existing consumer base. SELCO has an extensive network of customers in India already, through their successful solar home systems business. Adding cookstove provision to their business model allows them to offer energy services of a different, complementary kind in addition to their current model, adding new revenue streams to the company. Integrating the cookstove business directly into their existing business structures also adds the benefit of the microfinance component of the company to the cookstoves business, enabling access to a wider range of consumers, including the wide consumer income base already involved with the company.

Offering a micro-loan repayable over a short period for a cookstove product enables users previously out of reach of cookstove technologies, who are often the ones that would benefit most from a clean cookstove. Micro-credit models also facilitate regular contact between consumer and supplier, meaning that repairs and maintenance, for example the refurbishment of stove liners, can be done on a more regular basis. This, in turn, enhances product performance, and should improve consumer satisfaction with the cookstove product.

[2] http://www.selco-india.com/

Micro-credits are generally administered by micro-finance institutions (MFIs), who are the credit-providing organisation to the consumer. MFIs in this model enter into partnerships with clean cookstove companies (mostly sales companies/integrated companies). The MFI administers the credit necessary for the consumer to purchase the cookstove product or service, and the cookstove company retains responsibility for collecting repayments on behalf of the MFI, and maintaining/servicing the cookstove product. (Rao et al., 2009)

Loans can also be offered to entrepreneurs. For instance, the *Developing Energy Enterprise Program* run by GVEP[3] in Kenya had as part of its operations a loan guarantee program, offered through GVEP, to enable entrepreneurs to access finance to scale their clean cookstove businesses. The Women's Enterprise Development Institute, an umbrella organisation that manages *Accumulation of Savings and Credit Associations* (ASCAs) in Kenya, has also introduced the option for groups to link with suppliers of clean cookstoves or solar lighting products to develop businesses with their savings. (Rao et al., 2009 ; Palit et al., 2013 ; Rai & McDonald (eds), GVEP International, 2009 ; Clough, 2012)

3.3 The Effect of Donor Support & Subsidy in Achieving Scale

Some business case studies[4] have raised the point that donor subsidy was critical to businesses having the opportunities and capacity to achieve scaling. Donor support, whether in the form of capital grants, periodic financial assistance, technical assistance, networking or administrative help, can assist new and existing businesses in taking their services and products to a wider consumer base. Momentum in cookstove activities by a business, like continuing a scale of operations for a significant time in order to build a consumer base and consumer trust, has proven much more achievable with committed donor support, whether that is from NGOs or governments. For instance, the Sri Lankan clean cookstoves sector has seen significant government involvement over the last 30 years, enabling continuous market activity. Market cases across the developing world have identified that donor support, even if not in the form of subsidy, can have a significant impact on the scaling of clean cookstoves businesses.

Subsidies have been used in the majority of donor-funded projects for dissemination only. GIZ (formerly GTZ) has been active in both Sub-Saharan Africa and South America using direct and indirect subsidy models.

The Bolivian GTZ project from 2005 to 2007 used a decreasing subsidy rate of USD26 to USD15 for a high-quality metal rocket stove, although increasing metal prices hampered the withdrawal of the subsidy completely, eventually being complemented with the development of a microfinance scheme for project recipients. *EnDev* in Mali is an example where direct subsidies were used to assist market development. A start-up subsidy was given to a local craftsmen's association, who provided stove producers with material on a credit basis. This project was constrained, however, by another World Bank-run project in the country at the time, offering 50% direct subsidies on stoves in the first year, meaning *EnDev* stoves were priced out of the market.

[3] http://www.gvepinternational.org/en/business/energy-enterprises
[4] Bolivia, Ethiopia & Mali (Gaul 2009), Kenya, Uganda, Tanzania (Clough 2012).

Indirect subsidies are less common, although GIZ has used them with some success in Burkina Faso, subsidising training and marketing activities for clean cookstoves, and quality control through an independent institute, *Institut de Recherche en sciences appliquées et technologies,(IRSAT)*. GIZ financed the IRSAT through a direct subsidy of approximately €0.5 per stove over the course of the project.

Sale value of the stoves to households stood at 1,500 – 3,000 CFAF (USD1.56 – 3.12), with both stove producers and resellers retailing to the public. Total financing costs per stove disseminated dropped from USD13.13 in 2007 to USD6.12 in 2008, indicating a large increase in volume of stove production, corresponding with the 45,000 total sales figure attained during October 2008. (Rai & McDonald (eds), GVEP International, 2009; Gaul, 2009).

As of 2017, the project was continuing in collaboration with GIZ/IRSAT and the EnDev Burkina Faso mission. Phase Two of the project ran from 2009 to 2017, and enabled access to modern cooking energy for over 1.5 million people in Burkina Faso, as well as 2,300 social institutions (such as schools and community centres) and 2,300 small- and medium-sized enterprises. (EnDev, 2017)

3.4. Public-Private Partnerships and ICS

Public-private partnerships, or PPPs, have proven to be a useful tool in improving the reach and impact of renewable energy products and services, across a number of technology options. As a method for improving the dissemination of ICS, PPPs have the potential to scale up access to finance for businesses, as well as allowing government/NGO partners to achieve project goals in a more efficient and expedient manner. Market barriers to development, as well as the reach and scale of private businesses versus public bodies, mean that partnerships between private entities and civil society can be an effective way to increase consumer bases, as well as service coverage. (Bazilian et al., 2011)

Case Study: Sri Lanka

The Sri Lankan clean cookstoves market is an example of how businesses were able to grow more effectively when partnering with a public-sector body. The *'Anagi' stove* design is the most popular in the country, and production of the stoves is a long-established value chain in the country, with over 40 years of experience. Commercialisation of the cookstoves initially was done solely by the private sector, but in the 1990s partnerships with the state-owned *Ceylon Electricity Board*, as well as with NGOs entering the clean cookstoves market space such as *Integrated Development and Assistance* (IDEA), enabled the existing network of producers and retailers to achieve scale in their businesses much more quickly and effectively.

Assisting large scale producers in accessing the distribution value chain, allowing a focus on the social aspects of clean cookstoves from an NGO perspective to be integrated into design and manufacture, and a long-standing business infrastructure to develop; all allowed these partnership models to succeed in the country. (Rai & McDonald (eds), GVEP International, 2009)

The question of why utilities or other organisations, for example NGOs, engage in public-private partnerships is an important one to understand for the improved cookstoves market. For the *Ceylon Electricity Board*, and the participating NGOs in the Sri Lankan case, the partnerships allowed scaling of their operations in a reciprocal fashion with the cookstove businesses. This enabled NGOs to access market sectors, entrepreneurs and consumers not previously within their network.

It also enabled the CEB to expand its remit of public service provision in a cost-effective manner, giving consumers access to sustainable technologies within its services at significant scale, and providing new revenue streams for the company.

3.5 Clean Cookstoves and Gender Issues

An area of growth in clean cookstoves research over the last decade has been issues surrounding gender and energy poverty. Traditional family and household structures in developing countries, often involves women in the family being responsible for the collection of cooking fuel (if using traditional biomass fuels), as well as the cooking role in the household.

Some Indian state projects, for example the *Village Energy Security Program* previously mentioned, identified the potential for improving clean cookstove dissemination by directly engaging with rural women and women's groups, both economic and social. This approach has also been taken by some NGO projects in Sub-Saharan Africa, for example SNV projects in Kenya, empowering women through capacity building and training to either enter the clean cookstoves sector, or better understand the wealth of options available in transitioning to cleaner cooking solutions, and the benefits that the modal change to cleaner cooking options will have for them. These include a significantly reduced time burden on cooking fuel collection (if using traditional woodfuels), and the health benefits acquired from switching to cleaner-burning cooking fuels. (Shankar, Onyura & Alderman, 2015)

Analysis into the benefits of engaging women in the clean cookstoves value chain has been undertaken by the *Global Alliance for Clean Cookstoves* in the Kenyan cookstoves market. The study presented in Shankar, Onyura and Alderman (2015) showed the effects of engaging female entrepreneurs in clean cookstove sales operations, finding that female cookstove sellers outsold their male counterparts by three to one. High-selling (more than eight cookstoves in the assessment period) entrepreneurs were more than twice as likely to be female, and if women sold to other women, those consumers were more likely to report appropriate cookstove use, and more likely to report the benefits of using a clean cookstove.

3.6 Consumer satisfactions or the importance of tailoring Designs to Market Conditions

As stated in Rai & Macdonald (2009), "*Unfortunately a wide number of cooking technologies in the open market are not needs based and at times lack certain practical aspects as a result of not being tested beyond the laboratory*". In effect, the social structures surrounding cooking in communities are a factor that directly affects dissemination. If improved cookstoves do not fulfil the needs and desires of the target consumers, the impulse to switch from traditional/already-in-use cooking technologies to improved cookstoves is significantly diminished.

Experiences with projects and businesses in Sub-Saharan Africa and South-East Asia have shown that ignoring the consumer's current cooking needs and desires can lead to promoting and disseminating products that will not be adopted by the target market. Counter-examples include *Sustaintech* in India, an institutional stove manufacturer who benefited from consumer surveys influencing their stove designs; the SELCO project's cookstove dimension, also in India, and *Ugastoves*, based in Kampala, Uganda. *Ugastoves*' local manufacturing of components and employment of local artisans has helped them build products based around the needs of consumers first and foremost, contributing to their successful growth. (Rai & McDonald (eds), GVEP International 2009, Kariuki & Rai 2010, Palit et al., 2013)

There are a number of factors that can affect dissatisfaction with an ICS product in the developing world. Changes in the style of stove use can be a factor, for example if an improved stove is used on a tabletop rather than seated on the floor. Differences in cooking times also affect product satisfaction, for example if an improved cookstove takes longer to cook an evening meal than a traditional model (2-3 hours for some improved cookstoves compared to 0.5-1.5 hours for traditional cookstoves), satisfaction will be lower. Taste is also a factor: experiences with Sub-Saharan African clean cookstove programs have shown users often prefer the taste of food cooked on traditional biomass stoves, or those using charcoal, to an improved biomass or LPG cookstove. (Palit et al. 2013)

One of the less-examined factors associated with product dissatisfaction is the perceptions of the end-users of the fuel source used by the improved cookstove. There have been experiences in some Sub-Saharan African markets, for example the Kenyan clean cookstoves market, of users being dissatisfied with stoves because they have a desire for 'modernity', or to modernise, in terms of the fuel sources used in their homes[5]. A similar social phenomenon has been observed in the case of Ghana, with improved biomass stoves suffering low uptake rates due to the perception in the country that LPG is a better, cleaner, more modern fuel source, particularly due to the government's promotion and subsidisation of the technology. (Rai & McDonald (eds), GVEP International 2009)

In conclusion, market research, and in particular understanding the needs and desires of the local consumers in the target areas for a clean cookstoves business, seems to have a significant impact on business success and scaling.

[5] This has been shown, for example, in the solar lighting sector also, with solar lighting products experiencing low uptake rates because of the desire for grid or off-grid electricity connections, the solar lighting systems not going far enough to satisfy the desire to 'modernise'.

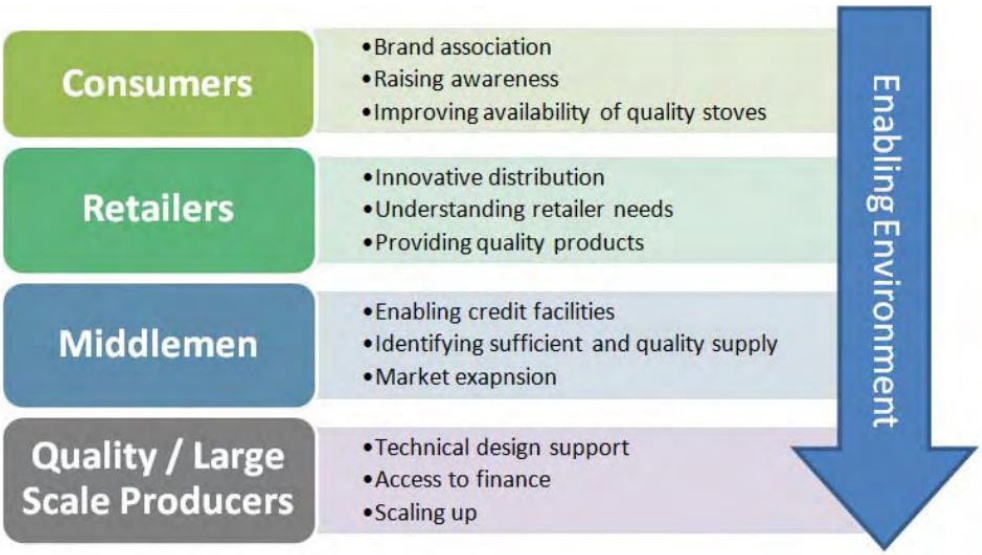
This can be achieved synergistically through the use of partnerships with local producers and consumer groups/cooperatives, ensuring that local voices are heard in the design and testing phase of new products, as well as in approaching scaling of a clean cookstoves business.

4.0 Conclusions

The challenges facing the growth of clean cookstove businesses and markets in the developing world are numerous; however the lessons and experiences learned from the markets and projects as they stand suggest that innovative solutions exist to overcome these challenges. The case studies in this paper suggest that some key approaches to clean cookstove business growth come at the very start of a business plan: targeting the correct market with the correct product. Understanding the target market and the needs of consumers, as well as their income levels and relative affordability perceptions, are key steps in designing an effective product and service option for a clean cookstoves business.

For policy-makers, it is clear that one of the major challenges facing the creation of enabling environments for clean cookstoves is the lack of financing institutions for new and existing businesses. Almost in all the cases presented, access to financing has been a major barrier to both new businesses entering the market, and existing businesses achieving scale. In countries with existing micro-finance infrastructures, like Kenya and Tanzania, national and local government policy can enable micro-finance institutions to access the clean cookstove entrepreneurial market, and allow entrepreneurs to access the necessary finance for the cookstove businesses.

Figure 7. Steps in improving the enabling environment for clean cookstoves



Source: Clough 2012.

The creation of an enabling environment can take the form of loan guarantees by the government, allowing micro-finance institutions to lend to entrepreneurs who may find themselves outside of normal requirements for accessing finance. State bodies acting as guarantors for lending can alleviate micro-finance institutions' requirements for recipients of loans. (Bazilian et al., 2011; Global Alliance for Clean Cookstoves, 2014).

Policy-makers can also influence the clean cookstoves sector through enabling the emergence of new cookstove entrepreneurs. Developing skills and capacity bases for clean cookstove entrepreneurship can help to create and develop markets for cookstove products. This can be achieved through running training programs on starting and running a business, as well as on business management, for example through book-keeping and accountancy courses. The experience of the *Global Alliance for Clean Cookstoves* in Kenya has shown that capacity building and training in business operations and growth has a great effect on the effectiveness of clean cookstove businesses undergoing this training. This is particularly the case when, as mentioned earlier, female entrepreneurs are recruited to take part in this training. Regardless of gender, however, the training and agency-based development program undertaken by the *Global Alliance for Clean Cookstoves* meant the entrepreneurs increased significantly their business capacity. Training on clean cookstove business considerations specifically has been shown to support the development of cookstove markets, for instance through the work of SNV in Tanzania and Uganda. (SNV, 2015; GVEP International, 2012b)

From an investor perspective, the clean cookstoves sector in developing countries offers a real opportunity for sustainable, and sustained, business growth and accessing the potential for business growth through investing in clean cookstove entrepreneurial projects would benefit both investor and business. Some routes to investor involvement in the clean cookstoves sector can be seen in the Kenyan market example, with savings and credit cooperatives beginning to offer cookstove products as investment choices to their members, as well as micro-finance institutions investing in, and partnering with, clean cookstove businesses.

For investors wanting to target the clean cookstoves sector, partnering with local producers and companies has been shown to have a higher success rate than directly creating a new cookstoves business in a sector. The local component in manufacturing and sale has proven to be a strong factor in consumer satisfaction and sales performance and bottom-up strategies involving local entrepreneurs and end-users tend to ensure the success of ICS program (Urmee & Gyamfi, 2014).

Questions & Answers

This section aims to help the reader to synthetize the main issues in clean cookstoves intervention design and offer solutions, and considerations that need to be made when designing a new business utilising clean cookstoves, extending a current business with clean cookstoves services or designing a NGO/government-led market-based project for clean cookstoves.

Identifying the Target Market and Market Conditions

Success of a clean cookstoves business or project often depends on appropriately targeting interventions based on the market for clean cookstoves technology in a given area. Clean cookstove programs in the developing world have a long history of limited success because of factors such as a lack of understanding of prevailing market conditions leading to the promotion of inappropriate solutions to consumer's cooking energy needs. This can be due to market-side issues, such as promoting unpopular, expensive or ineffectual products for the majority of consumer's wants and needs, or business-side issues such as a lack of financial support options for new, poorer consumers, or marketing cookstoves at an inappropriate price point for the market.

Key questions that need to be asked include:

- Which consumer segments should the business/project target? Middle-income consumers, bottom-of-pyramid consumers, or a variety?
- What are the prevalent cooking energy use modes in the targeted region? What are the targeted consumers using improved cookstoves as their primary cooking energy choice?
- What is the state of market development for improved cookstoves in the targeted area? Is there the potential to utilise local manufacturing, or will products need to be imported?

Targeting an appropriate consumer segment for the technology that is being promoted is important. For example, in the Kenyan clean cookstoves sector as detailed above, low-cost cookstoves were the market segment with the greatest growth, with low-income consumers being the main purchaser of these stoves, and hence local entrepreneurs began to create businesses based around the production and distribution of improved biomass cookstoves, with high local manufacturing content to keep costs down. In other cases, such as Ghana, government support for LPG technology meant LPG fuels and equipment came down in price, bringing the traditionally-higher-cost technology within reach of middle-income consumers[6].

A failure to understand cooking energy use modes in targeted regions has led to the failure of many clean cookstove projects. A number of Indian cookstove programs have suffered due to a failure to understand how people cook in their home (for example, state programs under the VESP), and an inappropriate design to that end; and other countries such as South Africa have experienced a failure of clean cookstove dissemination programs due to targeting a technology not suited to how people want to cook (for example, LPG, whereas consumers desire a similar cooking mode to charcoal stoves).

[6] More information on these markets is available in the LPG section of this resource guide.

Countries such as Sri Lanka have succeeded in targeting projects based around a successful stove design with extensive existing use in the market (the *Anagi* stove). Identifying opportunities based on the state of market development has led to growth in clean cookstoves markets, like in the Kenyan and Sri Lankan markets above. In the Sri Lankan market, NGOs identified the potential for large-scale production of clean cookstoves in the country in the 1990s, and engaged in partnerships with producers and the distribution value chain, from a state to local scale, in order to allow greater and simpler access for distributors to producers and vice versa.

Choosing a Clean Cookstove Product to Promote

Some clean cookstove products have been found across the body of research to be more appropriate to certain circumstances than others. This can be due to a wide variety of factors, commonly including technology costs, fuel costs, and the modalities of cooking energy use in the regions targeted by interventions.

Targeting a consumer group with an appropriate technology is vital to creating a successful, sustainable business with clean cookstoves. The availability of manufacturing and distribution capacity for various clean cookstove technologies in the targeted region for a business or project is another factor that needs to be considered as it can significantly affect revenue streams for a business, and success rates for a project. Local manufacturing capacity availability reduces up-front costs for businesses, enabling entrepreneurs to start business with lower initial capital requirements.

Conversely, if clean cookstove products of the chosen technology are only available through importation, then initial costs, and hence sales prices, are necessarily higher.

Some key questions to ask when selecting a clean cookstoves product include:

- What product is appropriate to the income level of the consumers I am targeting?
- What fuel choices are consumers currently making with regard to their cooking energy demand? What existing value chains and businesses for the fuels are present in the market, and how can this be used to support new business?
- What level of availability do various clean cookstove technologies have in the target market? What are consumers currently using, what price-points are these products selling at, what price-points are the products available at on a wholesale basis?

The Kenyan case above is a good example of the effectiveness of targeting consumers with a cookstoves product that is appropriate to their income level. The Kenyan market benefits from a strong local manufacturing sector for clean cookstoves, and the market has developed a strong presence in low-cost cookstove solutions, appropriate to the income levels of the largely rural cookstoves consumer base. Other countries such as Ghana have a developed mid-price clean cookstoves sector, particularly for LPG products given the government's involvement in promoting the LPG sector, and middle-income consumers have been targeted with these products by businesses in the country.

Understanding the modes of cooking fuel use for a targeted consumer sector helps to inform what technologies may be most appropriate for a particular market. For example, countries such as South Africa have struggled to achieve scale in the LPG cooking market due to the preference of many consumers for wood or charcoal cooking, on issues such as price and availability of fuel (often free in the case of traditional woodfuels), or qualitative considerations such as taste or ease of use.

In terms of utilising existing value chains, the Sri Lankan cookstoves sector has benefited from NGOs partnering with the state electricity utility, utilising the existing consumer base of the utility to easily target expansion of project operations, and support the development of a private cookstoves manufacturing and distribution sector.

Ensuring that a targeted cookstoves technology has an existing market presence in a country, and local manufacturing capacity or potential, allows projects or businesses to start on a more sustainable basis. Importing cookstove products increases costs for companies, which are then necessarily passed on to the consumer. Similarly, some World Bank and UNDP projects, for example in South Africa and Mozambique, have targeted cookstove technologies that are significantly more expensive, both in terms of fuel costs and equipment costs, than most users are willing or able to pay for. Understanding the price point that consumers are willing to accept for clean cookstove technologies has helped in some Indian state sectors in particular, for example SELCO's clean cookstoves business, directly benefiting from the company's experience in pricing for lighting solutions for bottom-of-pyramid consumers.

The Enabling Environment for Clean Cookstoves

When designing a new business venture in the clean cookstoves market, understanding the enabling environment that exists in the market in terms of state support for clean cookstoves technologies and business is important. Early movers in clean cookstove markets generally benefit from some level of government support, whether it is support for a pilot project on a public-private partnership basis, or through grant/loan funding to establish a business presence. Maintaining awareness of government priorities in the clean cookstoves policy space will assist in the design of effective and sustainable business interventions.

Pertinent questions to cover when considering the enabling environment include:

- What priorities do the national or local governments of your target region or market have for clean cookstoves? Are any specific technologies targeted?
- What support is available from the government for projects or business in the clean cookstoves sector? What potential avenues for public-private partnership exist?

Countries such as Ghana have had the clean cookstoves sector benefit to a large degree from (unrelated) government commitments to specific technologies, in this case the LPG sector. Developing indigenous refining capacity has improved the supply of LPG to the country, and indirect subsidies from the government (such as tax relief on LPG stove imports) have assisted in making the technology more accessible and sustainable in the country on a business base. Some Indian state government such as Assam have had programs dedicated to growing the biogas sector of the state, and state support for biogas digesters has allowed biogas-using cookstove products to find a space in the market.

A notable case of public-private partnerships benefiting the clean cooking sector in a country is Sri Lanka, where the *Ceylon Electricity Board (CEB)*, the government electricity parastatal, partnered with NGOs and private distributors to bring clean cookstove access to a much greater range of consumers, with the private sector directly benefiting from the scale and consumer network of the CEB's operations. Identifying potential public partners, either governmental or semi-governmental, has the potential to greatly benefit clean cookstoves initiatives. (derived from Stove+/GIZ (2014))

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Web Resources for ICS

Global Alliance for Clean Cookstoves: https://www.cleancookingalliance.org/

ISO/TC 285: Clean Cookstoves and Clean Cooking Solutions:
http://www.iso.org/iso/iso_technical_committee?commid=4857971

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