PARTNERSHIP FOR CLEAN INDOOR AIR (PCIA)

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This quarterly newsletter reports on the activities of the Partnership for Clean Indoor Air (PCIA) and its Partners to improve health, livelihood and quality of life by reducing exposure to indoor air pollution, primarily among women and children, from household energy use. More than 530 Partner organizations are working together to increase the use of affordable, reliable, clean, efficient and safe home cooking and heating practices. Visit www.pciaonline.org to join!

A special thanks to Jean Kim Chaix, Director of The Charcoal Project, who wrote this issue's introduction and helped coordinate this Bulletin's overall content.

Building on the past 10 years of groundwork laid by PCIA, the launch last year of the Global Alliance for Clean Cookstoves, the high profile endorsement it received from influential public and private officials, the significant financial commitments secured, and the recent release of a landmark study by Dr. Kirk Smith linking respiratory illnesses to dirty stoves have all placed a bright spotlight on indoor air pollution and the role clean cookstoves have in reducing associated health and environmental risks.

Traditional wood-burning stoves and open wood fires are the main culprits of toxic indoor air pollution. So it makes sense that much of the research, development, and investment over the past decade has focused on producing cleaner, more efficient wood-burning stoves.

Charcoal and briquette-burning stoves have generally received less attention. This is partially because, in some respects, charcoal is considered a better cooking fuel than wood due to its higher caloric content by weight and its lower contribution to indoor air pollution (particulate matter). In fact, studies show that "*a shift from firewood to charcoal ... can reduce indoor air pollution by 90% or more.*[1]" There is recent evidence that super clean wood-pellet burning TLUDs may compare very favorably to charcoal in terms of emissions but their distribution is still very limited compared to "rocket" stoves.[2]

If the focus is placed primarily on wood-burning stoves, it means that implementers, manufacturers, and funders may be overlooking important social, environmental, and economic benefits that charcoal and/or fuel-briquettes can deliver to the communities they serve.

What's more, expected shifts in solid biomass fuel consumption patterns in the developing world mean that business models will need to be tweaked, especially for large-scale manufacturers. The next page highlights a few reasons why the clean cookstove community should consider diving deeper into the fuel-side of the clean cookstove equation.

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In This Issue

From a business perspective, global urbanization trends over the coming decades suggest that the developing world will see an increase in demand for charcoal as populations switch to charcoal, fuel-briquettes, or even ethanol and LPG. One example is sub-Saharan Africa, where about two-thirds of the population lives in rural areas and consumes wood for cooking. It is estimated that the urban-rural population will be split 50-50 by 2030. This means that businesses hoping to achieve scale by focusing exclusively on deploying of wood burning stoves may face diminishing returns over time.

Traditional charcoal production is known to have a greater negative impact on the environment than the collection of wood for cooking fuel.[3] As urban populations demand ever greater quantities of charcoal for cooking, environmental degradation is projected to increase. Under a business as usual scenario, greenhouse gas emissions from charcoal production and consumption in sub-Saharan Africa are set to rise 140 – 190% by 2030.[4]

But this trend presents significant opportunities too, as stove programs currently engaged in selling carbon offsets could begin exploring additional carbon finance opportunities by teaming up with charcoal producers that employ lower emission technologies. Add a tree-for-fuel component and the opportunities increase even further.

In places where wood and charcoal may be growing scarce and/or expensive, entrepreneurs are finding that briquettes made from agricultural waste or other solid biomass can compete with more traditional fuels while also generating income for families and communities. More investment and research in this sector is required, however.

Of course, many stove projects simply do not have the ability to make much of a difference on the fuel side of the equation and must therefore work with the fuels they have available. Still, if there is one take-way from this edition of the Bulletin, it is that, in designing stove programs and technologies, it is important to take into account fuels and the social and environmental context in which they occur.

In this 29th issue of the PCIA Bulletin we've reached out to a variety of experts around the world and asked them to share their views on a range of issues relating to charcoal and fuel-briquettes. We hope Partners find ways to incorporate some of these lessons into their programs.

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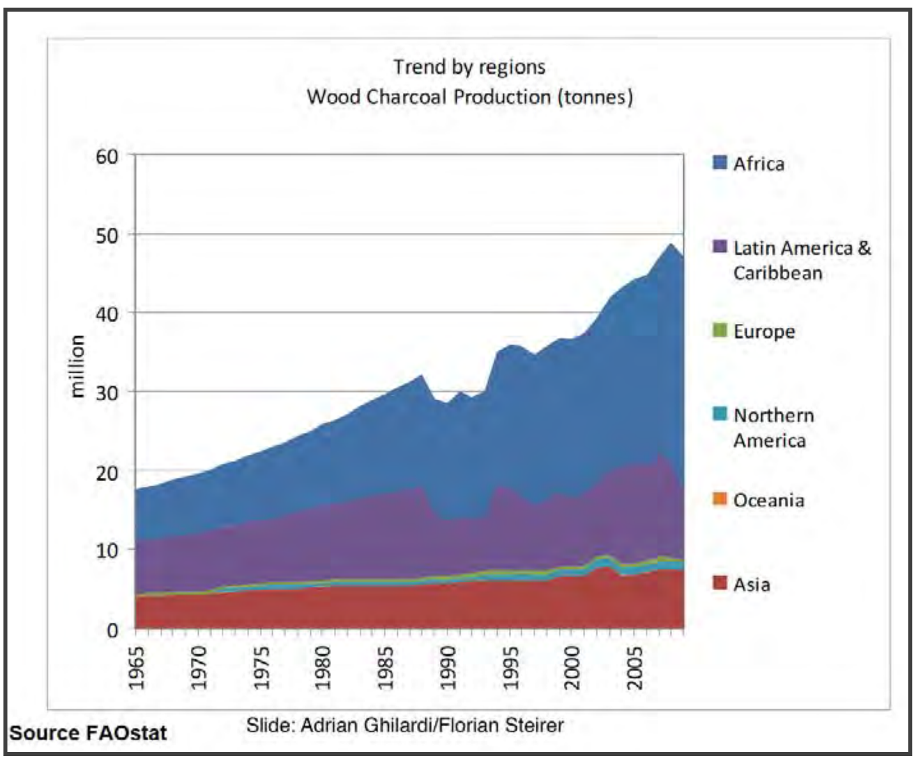
[1]Bailis, Ezzati, Kammen. Mortality and Greenhouse Gas Impacts of Biomass and Petroleum Energy Futures in Africa. *Science*, 1 April, 2005, 308.
[2]See PCIA webinar – EPA lab test results for household cook stoves at http://www.pciaonline.org/proceedings/webinar-epa-lab-test-results-household-cook-stoves
[3]Is a charcoal crisis looming for Tanzania? The Charcoal Project. Interview with Dr. Tuyeni Mwampamba. January, 2010.
[4] Bailis, Ezzati, Kammen. Mortality and Greenhouse Gas Impacts of Biomass and Petroleum Energy Futures in Africa. *Science*, 1 April, 2005, 308.



FEATURE ARTICLES - Briquettes

Overview of Briquettes and Comparison with Traditional Fuels

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The **Legacy Foundation** (LF) is a U.S.-based non-profit (501c3) organization. The Legacy Foundation's mission is to promote sustainable human development and preserve our environment through the integration of technology innovation, media, and management.

LF founders and staff have worked since 1994 to introduce a singular and effective solution to both fuelwood-based forest destruction and rural poverty: *hollow-core biomass-based briquettes manufactured in simple and inexpensive wooden or metal presses by micro-enterprises, often led by local women.* These briquettes can be manufactured from virtually any biomass material, including agricultural waste (leaves/ grasses/straw/husks), scrap paper, or sawdust. Their production and use generates local income, reduces the consumption of conventional fuelwood, and requires very little capital to initiate.

Photo credit Peter Stanley

Mkombozi Women's Group members Lushoto Tanzania preparing materials

LF began introducing and building capacity for these biomass briquettes in Malawi in 1994, and it has subsequently developed projects in Uganda, Tanzania, Kenya, Mozambique, Zambia, Burkina Faso, Nigeria, Ghana, South Africa, Mexico and Perú. The most effective methodology, developed from these experiences, involves three critical components:

- Introducing the technology by training a group of local producers;
- Launching a national marketing campaign that shows the economic and environmental benefits of the biomass briquettes; and
- Training, from among the most capable initial producers, trainers who will extend the technology to many additional villages and producer groups.

Now, working with more than 25 NGOs worldwide, LF supports development, extension and capacity building to introduce low cost biomass briquette-making technology for small-scale entrepreneurs and community groups. Legacy's primary focus is to support local groups, especially women's groups, to become totally self-sufficient in the briquette production activities – increasing income while saving time and labor. In the same context, briquette production conserves the environment through reduced dependence on and consumption of fuelwood for cooking and heating.

LF supports its associates through online technical assistance, encouragement, and networking connections and considers its greatest accomplishments and the overall goals of any project to include[1]:

- The self-reliant development of training capacity by those LF has trained.
- The reduced demand in participating communities on use of wood for fuel, thus preservation of forests.
- The development of regional networks of biomass briquette producers and trainers through timely and thorough technical assistance to all on-line requests.

LF, for example, is presently completing a very successful project in Uganda and Tanzania, financed by a three-year grant from the McKnight foundation, focused on training of trainers. This project has trained thousands of biomass briquette producers, has helped to establish a regional network of biomass briquette trainers and has led to the establishment of an East Africa Biomass Producers Network.

Based on Legacy Foundation's experience, we believe that fuel briquettes should be an option for all clean cook stove programs. That said, fuel briquettes made from agricultural residues and commercial processing wastes have a specific niche. They are at once easy to produce and use, but sometimes involve more labor than simply gathering nearby wood. Generally one briquette producer using any of several hand-operated devices can produce enough briquette fuel for between 60 and 200 persons a day, depending upon press, material processing type and blend used. In areas with easily and safely accessed fuel wood (e.g. where someone can gather a week's worth of fuel in one day), briquettes will find no real market unless subsidized by the government or other donor institution, which is not sustainable. However, if there is an increase in the distance/difficulty and/or decrease in the safety of access to that fuelwood supply, the market will tend to favor the biomass briquette.

Photo credit Peter Stanley

Mkombozi briquettes made from leaves, sawdust and charcoal dust

Briquettes can be made to fit a variety of stove shapes and sizes (as sausages, small wedges, cylinders or squares between 30 to 150 mm in diameter x 30 to 75mm height), and can be made from a range of blends (from mostly waste charcoal and paper blends to pure agro residues). It is not the briquette type or thermal output, or even cooking habits or stove design that is critical to briquette adoption. Rather, it is the issue of their economic and 'fuel-gathering-security' advantage over wood and charcoal which determine their potential as a viable alternative fuel. Key to the briquette option, and an added advantage, is the fact that briquettes can be monetized allowing the user to provide a means of incentive and payment for the cook stove—and that seems to be a big hurdle to many cook stove extension efforts.

Pros and Cons of Non-Carbonized Briquettes

Pros: The non-carbonized briquette does not require the generally polluting and time consuming char-making effort. Instead, it utilizes existing waste char fines and crumbs from charcoal sellers. Charcoal dust and crumbs account for as much as 20% of the charcoal being offloaded, stacked and repackaged for individual sale. If you add about 20% charcoal dust and crumbs to an otherwise standard agro-residue briquette, it can generate the same amount and type of heat as char briquettes. The biomass briquette, whether made with charcoal additives or not, can be choked down towards the end of its burn to generate char as well.

Cons: Biomass briquette production requires water (100 kgs of briquettes require anywhere from 2 to 300 liters of water depending upon blend and press used). Briquettes also require four to six days to dry to ambient conditions before they can be used. Open-air storage of four to six days' production is therefore necessary with this process.

Required Materials for Briquette Production

There are about twenty five different types of presses and a least four different processes for grinding/ chipping/ mashing materials by hand. Hinges, screws, ratchets, hydraulic jacks, levers and other more technical mechanisms, ranging in cost from a few dollars to several hundred dollars, are constructed from metal, wood, or even cement and plastic, and can require from one to a dozen operators. The same, although to a lesser extent, applies to threshing, chopping and mashing technologies for preparing the agro residues. For more information on the range of presses available worldwide, you can contact the fuel briquette network at fuelbriquetting@googlegroups.com

Photo credit Peter Stanley

Mkombozi Women's Group Members making briquettes with the wood press

The choice of which type of press to use is best determined by a full survey of the production culture, resources and skills and the market it is intending to reach.

Challenges

The notion of compressing biomass, which in its original form is of lower thermal value per kg than fuel wood and charcoal, into a fuel which can match or even exceed the output of wood or charcoal per unit weight because of its unique shape and blend, challenges conventional wisdom and therefore acceptance in the local markets.

At the same time, because briquette production appears so easy, it is sometimes replicated without comprehensive understanding of the correct briquette-making process; this results in inefficient production or a poor-quality, low thermal output and a smoky product. One smoky briquette producer can quite easily damage the credibility of ten other good quality producers.

Briquette production of this type does not easily lend itself to the model of wide spread distribution from mass production centers because of the briquettes' high bulk relative to their weight. A full chest-high guinea sack can only contain 100 briquettes with a street value of only US $4 to $6, reaching a market of roughly 40 to 50 persons a day. The added cost of transport and the easy replicability of the production in surrounding markets tends to limit its widespread distribution from any one center except in more densely populated urban areas.

Opportunities

Briquette production is relatively easy to start up, with little investment. With engagement of local artisans, locally managed training and solid assessment of the real market for biomass briquettes, and with locally-managed training and extension services in effect, biomass briquettes have the potential to provide a completely self sustaining solution for ameliorating the effects of deforestation due to over demand of fuelwood and charcoal. We have just completed a program in Uganda and Tanzania which started as a training of two small producer groups and has led to the development of four well established briquette training and press production businesses. These businesses have trained more than one-hundred producer groups. The trainers are thus successfully extending the reach and impact of biomass briquettes in Uganda and Tanzania. In situations where the trainees cannot afford to pay the trainers with cash, we have seen briquettes used directly as payment for training, thus providing a win-win situation for both the trainee and the trainer.

The spread of the biomass briquette technology tends to follow a molecular/ cottage industry, sustainable pattern of growth, rather than the more conventional larger production-center based business model. This, coupled with increased internet and cell phone prevalence in developing nations, has enhanced local ownership of the process. Local producers are increasingly contributing to the growth of awareness about the product and access to briquettes and training.

Photo credit Peter Stanley

Extracting a briquette from the Ratchet Press, Lushoto Tanzania

We are now aware of briquette production or training activities in 46 countries. Yet, we see this as only the tip of the iceberg. The potential briquette-using populations in these countries are much larger than the current adoption rate.

Locally owned and managed biomass briquette production needs to be increased dramatically to reach more potential users—and it can with very little effort or cost. Legacy Foundation provides a free information-planning sheet for assessing the potential of a briquette production project in your area. Briquettes can be easily tailored to the needs of each individual clean stove-promotion program. They can also be used to finance the stove projects' expansion and sustainability.

[1]Legacy Foundation reports from projects with McKnight foundation, 2007-2010.

Recycling Charcoal Dust into Marketable Briquettes in Kenya

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Around 10% of Africa's charcoal is thrown away before it reaches the stove, representing a tremendous waste of precious biomass in an industry already under fire for inefficiency and poor environmental practice. A combination of brittle charcoal, long journeys over rough roads to market in overloaded trucks, and careless handling of bags all contribute to the pulverization of the chunks into particles and fine matter that consumers simply won't buy, as they would fall through the grate of most popular stoves. A few enterprises in East Africa have seen the opportunity to salvage this material and convert it to commercially viable fuel. One such industry, Chardust Ltd. in Nairobi, Kenya, salvages around 8 tons of charcoal waste per day that would otherwise be discarded, and through a process of sieving, milling and densification with binders, recycles it into marketable briquettes.

Salvaged charcoal waste suitable for briquette production

Crucially, in a market where environmental credentials hold little sway, Chardust's briquettes are priced more cheaply than regular charcoal. This is possible because the company's raw material is found within Nairobi city limits, close to both the production facility and the key urban markets, significantly reducing transport costs for inbound dust and outbound briquettes compared with regular charcoal, which is transported hundreds of kilometers at high cost.

Unloading charcoal dust at Chardust's factory for recycling into briquettes

Chardust's pricing (at around $140/ton ex-factory) places the briquettes well below the urban wholesale price of charcoal. However, standard charcoal dust briquettes are not necessarily a direct substitute for lump charcoal. There is a trade-off between price and performance. Briquettes have more ash and a lower heating value, hence they light more slowly. At the same time, however, they do burn for longer, giving off steady heat with no smoke, sparks or smell. Experience suggests that business and institutional consumers are prepared to sacrifice some heat output and light-ability if money can be saved per unit of effective energy, and the company sells most of its output to poultry farmers (for heating chicken houses) and restaurants, hotels and safari camps for space heating and water heating. Sales of a lower ash variety are also made in small package sizes to the urban middle class for barbecue fuel, a market segment that is growing fast and is less price-sensitive. Penetrating the mass domestic market has been more challenging as the fuel is not a like-for-like charcoal substitute and low income households are naturally conservative when it comes to matters as fundamental as cooking fuel.

The experiences of Chardust – and other start-ups in Tanzania, Uganda and Rwanda – suggest that high charcoal prices are a pre-condition for the sustainability of a briquetting enterprise of this nature. The company estimates a cut-off point of around $200 per ton for charcoal sold by the sack at the point of delivery to urban wholesalers: if charcoal is available more cheaply than this – as it is in many sub-Saharan African cities endowed with well-wooded hinterlands – then factory-made briquettes will face a hard time competing. Alternatively, in high-price charcoal cities with heavily depleted supply zones, there is good potential for replication of this business model. Viability is further helped by high levels of charcoal consumption, cold night-time conditions (e.g. at high altitude) and a lack of affordable energy alternatives. These factors make Nairobi, Kigali, Addis Ababa and many cities of the Sahel potentially ideal locations for spin-off industries, while Maputo, Lusaka and Kampala represent less viable locations.

Chardust (www.chardust.com) was the first company in Africa to identify and commercially exploit this resource, and has been in business since 1999 - so the business model is clearly proven. Its owners nevertheless caution that this is no get-rich-quick scheme, and should ideally be appended to an existing enterprise where land, infrastructure and administrative staff can be efficiently shared. The cost of starting up this type of business is around $50,000 using Indian-made roller presses, and assuming transport services are out-sourced.

Woman selling Chardust briquettes at retail kiosk in Nairobi's Kibera slum

Waste to Wealth Project in Tanzania

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ARTI-TZ started the Waste to Wealth (W2W) project in 2006 realizing that charcoal, however destructive it may be, cannot be eliminated from the lives of Africans for the foreseeable future. Hence it was, and still is, pertinent to find reliable ways to mitigate the forest destruction associated with current charcoal production without sacrificing peoples' incomes and livelihoods.

This is the rationale and the motivation behind the Waste to Wealth project, which aims to empower rural inhabitants, especially existing charcoal producers, with knowledge through hands-on practical training on how charcoal can be made from agricultural waste and any other dry biomass which is locally available and free.

In 2011 our efforts were boosted with funding through the World Bank's Biomass Energy Initiative for Africa (BEIA) to conduct a pilot project in which we train 1800 people in 60 villages in the 4 districts bordering Dar es Salaam, where 50% of all charcoal in Tanzania is consumed. So far we have completed training in two districts and are now working on helping these villages commercialize their briquette enterprises.

How it works

ARTI-TZ acts as the innovation broker developing the charcoal briquette value chain through the Waste to Wealth project. The project is currently focused at the producer level, training and equipping villages to fabricate their own kilns, produce charcoal powder from agricultural waste and other dry biomass and make charcoal briquettes.

An instructor engaged in Q&A after the ½ day of business training

As each new village gets trained, we link it with other trained villages, creating a network that becomes its own community-based enterprise, or CBE, focused on briquette production, sensitization and sales.

ARTI-TZ supports the CBEs to set up their production processes and develop their enterprise skills. Once a CBE has demonstrated its commitment to the production of charcoal briquettes, ARTI-TZ supports them with an electrical briquette extruder, a machine with a screw pin and a motor that compacts the char powder into briquettes. The briquette extruder is provided on loan, which the CBE slowly pays back with briquettes.

ARTI-TZ also trains and supports local leaders who work as "District Champions" attending all the trainings, liaising with the CBEs, and providing technical and motivational support at the local level. In 2012, we hope to start working more on supporting the CBEs in branding, marketing and creating sales networks for their briquettes.

The Technology Involved

The technology originates from ARTI-India, a research and technology institute based in Pune, India. With the blessing of ARTI-India, ARTI-TZ adopted the technology seeing the huge potential for application in Tanzania.

The kilns we use to produce the char powder are made from used oil drums. Initially we used larger kilns that required nine drums to produce. We have since changed the type of kiln we use to a smaller one that requires only two oil drums to fabricate, which is much cheaper and produces char powder more efficiently. We are constantly trying to improve on the kiln design to have good quality char powder at a reasonable cost. We are also always exploring new equipment to produce briquettes more efficiently and cost effectively, keeping in mind the importance on using simple technology that is easy to train producers to use.

A team of 3 operating the manual extruder (one cranking, one feeding and one collecting briquettes)

Community Benefits

While the Waste to Wealth project is still in the pilot stage it is already proving to be a viable alternative to wood charcoal and a great benefit to communities. People no longer have to go to the forest to cut trees for charcoal, as they can now turn to any dry biomass to produce charcoal briquettes. While some producers rely on a single source of dry biomass, such as wood shavings from large wood working shops, coconut husks, or coffee husks from agro industry, many rely on a combination of dry biomass, combining agricultural waste with other locally available materials.

The District Forest Officers, who are responsible for issuing permits to cut trees for charcoal production, have provided incredible support in terms of time, knowledge and working space. In the past they had no choice but to issue permits as there was no alternative to wood charcoal. Charcoal briquettes now offer them that alternative.

A trainee showing her first charcoal briquettes

Women have also started to benefit from the charcoal briquette trade, as production can be carried out closer to home and in conjunction with other agricultural activities. Unlike the traditional charcoal trade, charcoal briquette enterprises are proving to be more gender balanced.

Challenges and Opportunities for Program Expansion

Currently, the charcoal briquettes supply does not even represent 1% of the estimated 650 million USD trade in charcoal annually in Tanzania. In order to reach 1% or even 10% of this industry we must invest heavily in training and equipping rural producers as well as generating market demand for charcoal briquettes through sensitization campaigns and overall value chain development. Work also needs to be done to create policies and incentives to help facilitate the transition from wood charcoal to charcoal briquettes.

Comparison of Fuel Briquettes to Charcoal

One of the major concerns that people raise when you first introduce them to the charcoal briquettes is the quality. Some typical complaints revolve around the ash content and the quality of the flame and heat produced. The truth is that the quality of all charcoal, including wood charcoal, is determined by the process of carbonization. The quality is determined by the amount of heat produced, the burn time and the ash content. After five years of producing charcoal briquettes we are confident that charcoal briquettes can compete with wood-based charcoal in terms of quality and performance.

When people ask me about the quality of charcoal briquettes I always like to tell the story of the time I travelled to Africa as a teenager. Coming from Canada I only knew charcoal in briquette form. The first time I saw wood charcoal I did not believe it would work. I thought it was unrefined, inefficient and dirty. Not being familiar with wood charcoal I required “sensitization” to learn that it was the same as charcoal briquettes. While the situation is reversed, the same process of “sensitization” is required to convince people that charcoal briquettes are equal in quality to wood charcoal. We are already seeing the benefits of sensitization within the villages trained. People are starting to use the briquettes in their homes and give samples to friends and neighbors. The demand will grow as more and more people are exposed to the briquettes.

Cost

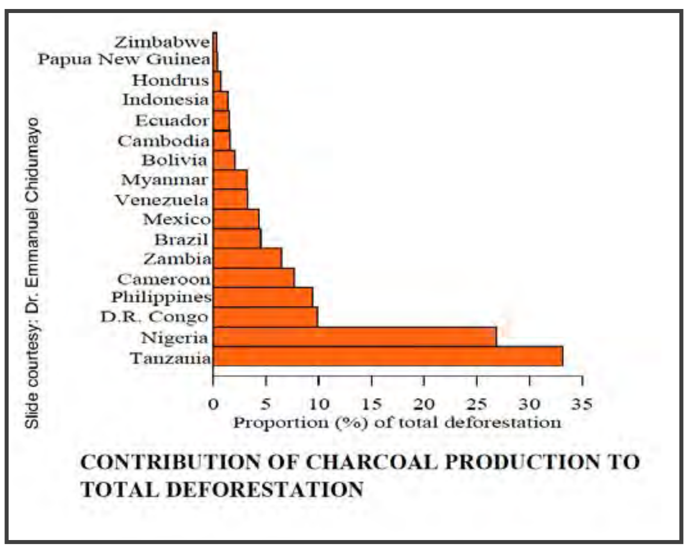
At the end of the day in order to compete with wood charcoal, charcoal briquettes have to be cheaper and as readily available. We always try to encourage briquette producers to mimic the existing market in terms of packaging and pricing. For example, if the charcoal is sold in 50 kilo bags for 25,000 Tanzanian shillings, the briquettes should also be sold in 50 kilo bags, but for around 20,000 Tanzanian shillings. If a paint can full of charcoal sells for 1000 shillings, then our CBEs should sell briquettes for 700 shillings. We have had success with this pricing strategy, with our producers selling at this lower price and still making about 40% profit.

Collecting the briquettes as they are being produced

The Future of Charcoal Briquettes in Tanzania

The Waste to Wealth pilot project has given us an enormous platform to gain support for a sustainable charcoal briquette industry in Tanzania. By March 2012 we hope to have five CBE’s up and running. We will then use these CBE’s to promote and encourage others to further invest in the CBE’s or set up their own briquette enterprises.

We are also speaking with the World Bank, the Ministry of Natural Resources and Tourism (MNRT), the Rural Energy Agency (REA), TaTedo, and donors to support the further expansion of the briquette industry to see it through its infancy.



Waste to Energy, Charbriquette Production Plant in Phnom Penh: An Initiative to Enhance the Local Economy while Preventing Deforestation

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Phnom Penh, like many other cities in developing countries, struggles with environmental and social issues within a relatively poor economic context. The city is seeing a growing demand for wood charcoal, which contributes to deforestation, while at the same time facing the pressing issues of urban waste management and high unemployment.

Since 2007, the NGOs GERES (Group for the Environment, Renewable Energy and Solidarity) and PSE (Pour un Sourire d'Enfant) have partnered together to establish an enterprise that can produce charbriquettes made from urban organic waste. This enterprise also respects social principles, and has created jobs for poor people who used to live directly on the public dumpsite.

The main objectives of this project are to:

1. Establish a new and independent enterprise with dedicated full time staff, capable of reaching economic profitability within a short period (3-5 years);
2. Implement a production line with a minimum daily capacity of 500kg of high quality, standardized charbriquettes;
3. Develop innovative and efficient equipment to produce char from organic waste without releasing smoke, and recycling the heat produced;
4. Collect appropriate organic waste within Phnom Penh city, starting with coconut residues;
5. Develop a marketing strategy for the charbriquettes to generate demand.

Technical results

As a rule of thumb, good quality charbriquettes require good quality char. This project has provided an opportunity to develop efficient, appropriate technology to process bulk biomass that maximizes char and charbriquette quality and minimizes environmental impact.

Based on T-LUD (Top-Lit Up Draft) gasification technology initially introduced by Paul S. Anderson, GERES has designed a *natural draft T-LUD pyrolyser* which is able to produce good quality char from bulk biomass (coconut husk/shell, corn cobs, etc.), and burn the smoke that would otherwise have been released. This device has several advantages: it produces consistent quality char, provides heat from the combustion of the "producer gas" for additional activities, minimizes environmental impact through clean combustion, and is easy to operate, affordable and locally produced.

The natural draft T-LUD pyrolyser

Using this T-LUD pyrolyser, GERES has also designed:

- A "charring-to-drying" module that can dry collected organic waste with the heat generated by the *TLUD pyrolyser* during carbonization. Efficiency of this module has been lower than expected and requires further research and development;
- A charbriquette dryer that also uses the heat from the *TLUD pyrolyser* to dry the finished charbriquettes. This dryer is still under evaluation. Proper drying is crucial to maintain a high quality, consistent product.

The design of the *TLUD pyrolyser* was validated. The main technical problem faced during operation has been the short lifespan of the locally-sourced construction materials (lack of high quality refractory ceramic).

The briquetting technology used has been the extrusion method, which enables the production of dense and high quality charbriquettes. Using a screw press, charcoal and a binder mix are pushed through a die to create uniform biomass briquettes. Nevertheless the wear on the extruding screw has been a serious technical problem, and requires weekly maintenance! Given that wear on the metal screw can only, at best, be delayed by treating the metal (hard-facing, often at incredibly high costs), the preferred solution has been to internalize the maintenance, with a dedicated staff member in charge of rethreading/reconditioning the screw regularly.

Business results and impact

The enterprise established by this project was registered in Cambodia as SGFE (*Sustainable Green Fuel Enterprise*, www.sgfe-cambodia.com), and currently employs 16 full-time workers to produce 550kg of charbriquettes per day.

Sustainable Green Fuel Enterprise charbriquettes

In order to provide socially fair working conditions, SGFE had to compromise on its competitiveness: better working conditions translate into higher production costs and thus higher prices of the end product, leading to low competitiveness. As a manufactured, high quality, socially and environmentally responsible product, charbriquettes cannot be cheaper than traditional charcoal at this time. Charcoal usually comes from unsustainable sources made from wood which is gathered for free or at relatively low cost, and is produced by farmers under unfair working conditions. Thus, traditional charcoal could be considered an illegitimate loan taken from future generations.

SGFE charbriquettes are about 30% more expensive than charcoal. Most of the local charcoal consumers are not yet ready to pay for its higher quality (a standard shape/moisture content, superior calorific value, and a consistent price) even though they recognize it. Economy of scale in production is the key to keep the fixed costs low, thus enabling the charbriquettes to be competitive with charcoal. A capacity of 2 tons/day was estimated to be a minimum within the Cambodian context.

The national market should remain the main target. However, given that initial sales could be very slow, international market sales can be a viable option to reach profitability for the business in the short term. National market sales would also allow the project to leverage carbon credit markets, under specific conditions, since one benefit of replacing fuel from unsustainably managed forests with organic waste charbriquettes is the reduction of C02 emissions.

As it is quite an unknown product, the real challenge remains to raise awareness in the local market of the superior benefits of charbriquettes over charcoal. An impressive marketing plan and campaign reaching out to the target users is required. This planning has to be well defined at the initial stages, with a significant dedicated budget.

Raw materials concerns

Good quality and competitive charbriquettes require inexpensive and relevant raw materials. Organic waste has been selected accordingly: priority was set on highly carbonaceous material with low moisture content (ideally, coconut shells). An important parameter to consider about waste is the cost of collection and preparation. Given their nature, raw materials can be expensive! Direct charcoal residue/dust from industrial processes was identified as another promising source of economically competitive raw material, but these materials have to be carefully selected based upon their suitability, in terms of ash content and fixed carbon. Business strategies must include securing long-term availability, quantity and cost of raw materials.

Note about CO2 emissions reductions

Reduction of C02 emissions is another benefit of replacing fuel, such as traditional charcoal coming from unsustainably managed forests, with organic waste charbriquettes. Appropriate methodologies exist for these types of projects to access carbon finance; however, specific conditions must be met. Notably, the non-renewability of the replaced fuel has to be proved, comprehensive monitoring activities have to be implemented, and production capacity has to be high[1] to offset carbon finance access costs (PDD writing, independent verification, registration, validation). A clear strategy regarding carbon finance has to be defined at an early stage of the project, and any additional revenue generated should support the establishment of large-scale dissemination of sustainable biomass fuel (snowball effect).

Conclusions

A project like this has to be implemented as a company, based on a strong business plan written at the project planning phase. Likewise, and particularly for NGOs providing early support, a realistic exit strategy is crucial to ensure the business will not be affected. Such a strategy may include partnerships with external investors/companies.

To be successful, a charbriquette production plant will have to set priorities and create a balance between social/environmental benefits and business sustainability. Carbon markets can be a significant part of a financial sustainability strategy, but the project implementer must consider it carefully, keeping in mind that production capacity is a key criterion for eligibility. Regarding the technology, the *TLUD pyrolyser* has great potential as an appropriate and efficient char-making device. Lastly, the establishment and enforcement of government regulations to curb illegal charcoal supply remains the key to unlocking the potential for charbriquettes to become a viable alternative to unsustainable charcoal.

[1] It is difficult to set a general threshold that depends on economic parameters, but production capacity has to be at least several tons per day.

Sustainable Fuel for Poor Communities

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Out of 28 million people in Nepal, 24 million (86%)[1] depend on traditional fuels – firewood and other forms of biomass -- as their main fuel source. Forest coverage is less than 25% of the total area of the country. In rural areas, people use dried cow dung as fuel mixed with grass and leaves for cooking food. Since cow dung is used as organic fertilizer in most parts of the country, housewives are responsible for collecting fire wood in the forest or bringing fodder from the farm. They usually spend a day collecting about 20kgs of firewood, which lasts hardly three days. Firewood collection is a big headache for the rural women as forests are mostly regulated by the community forest users' groups. Since people are depending mostly on fire wood, the forests are depleting very fast and degrading the local environment. People are willing to put up with the smoke emissions from fire wood and fodder because their ultimate aim is to cook food for their family by any means.

Commercial fuels such as kerosene, LPG and electricity are not only unaffordable but also inaccessible to rural people in Nepal. Rural communities are now facing hardships in managing fuel for household use. Due to frequent price hikes in fossil fuels (LPG and kerosene), poor supply, and lack of alternative energy sources introduced, low income groups in Kathmandu are suffering from a lack of available cooking fuels. Firewood in Kathmandu is not readily available in desired sizes and people are not allowed to burn firewood in rented houses due to smoke emissions.

Cow dung, bee-hive and log briquettes are not feasible to produce in urban areas as the raw materials for making these briquettes (cow dung, banmara and rice husk) are not available in the cities. Urban wastes can be used in producing fuel as it contains about 70% degradable items (agricultural, garden, and kitchen wastes etc.), waste papers (newspapers, mail, journals, packaging wastes etc.), and can be collected from businesses, homes, schools, and hotels.

Low income groups in Nepal urgently need low cost alternative fuel sources that can immediately relieve their hardships by utilizing local waste resources. We have an abundant source of waste materials in rural and urban areas which are piling up, polluting the local environment and have not been tapped for producing low cost fuel.

A lot of waste is generated at home, in the garden and on farms, such as food waste, packaging waste, paper waste (newspapers, mail etc.), and biomass waste. All these waste materials have their own economic value if they are segregated and reused or recycled to produce efficient fuel briquettes. FoST's fuel briquettes are made from biomass waste with paper pulp as a binder. Such briquettes can be easily made manually at home without costly machines and stored for a long time.

Finished briquettes drying in the sun

FoST has been involved in providing training for making fuel briquettes since 2004 to the rural communities with limited forest resources. We've had good success, including at a leprosy rehabilitation centre, Shanti Sewa Griha in Kathmandu, where we introduced this process in 2007. They are now using fuel briquettes for about 800 people for cooking food two times a day. They were spending about US$750 per month for L.P. Gas before briquette training. Processing five kgs of raw materials (one kg paper and four kgs saw dust) takes three hours in the morning including pressing. Drying takes a whole day in the sun, by sun set briquettes will be ready for cooking in the evening. Only a few hours of effort can provide two days' fuel for a family of four (70% of five kgs = 3.5 kgs).

Briquettes ready for market

Here is a comparative chart of an average family's fuel consumption for several types of fuels and the tentative cost estimates as per current market prices.

The below chart is based on FoST's research and tests, which show fuel briquettes as a low cost fuel option. If the communities themselves produce the briquettes, they will cost less than half of the above cost.

Comparative Chart of Fuel Consumption

(Average for family of 4 in Kathmandu eating two meals per day = 15 liters of boiling water per day)[2]

					Cooking time and fuel cost/day		
Type of Stove	Boiling	Quantity (ltr)	Fuel required	Unit	Time	US$/kg/ltr/ pc	Fuel Cost*
Firewood	Water	15	6	kg	4 hrs	0.12	0.72
Kerosene	Water	15	0.75	ltr	3 hrs	0.93	0.70
LPG	Water	15	0.5	kg	3 hrs	1.18	0.59
Beehive briquettes from banmara and clay	Water	15	2	pcs	3 hrs	0.37	0.74
Fuel briquettes (saw dust and paper)	Water	15	1.5	kg	3 hrs	0.24	0.36

* as of 18th November, 2011, Exchange rate: US$1 = NRs.82.

In the present context, we believe that an effective solution to the problems identified is the production and use of fuel briquettes, a non-charred, non-pollutant, environmentally-friendly, easily applicable fuel for cooking, water heating and space heating as well as generating a sustainable income source based on waste in the community. We believe it is a sustainable fuel for poor communities.

[1]National Energy Situation Survey Report– Focus on Renewable Energy and Poverty Reduction. Centre for Rural Technology, Nepal, July 2005.
[2] FoST's regular research results.

Cooking with briquettes

The Role of Briquettes in Curbing Haiti's Charcoal Consumption

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In 2006, UNDP launched a waste management initiative in Carrefour Feuilles, Haiti, which included the production of briquettes made of paper/cardboard waste and sawdust. In its first four years of operation, this briquetting program provided employment opportunities for about 40 Haitians, greatly improved sanitation in the local community and contributed to a reduction in the crime rate. However, without a reliable market for the briquettes it was producing, the long-term sustainability of the program was far from certain.

Final step in the briquette production process — factory employees releasing briquettes from their mold to dry in the sun

Fortunately, just a few weeks after that earthquake hit, the International Lifeline Fund ("ILF") arrived in Haiti with the goal of implementing a sustainable energy program that could help reduce that country's reliance on wood and charcoal for cooking. Shortly before launching that program, ILF had learned about a new highly efficient institutional stove from India ("the Prakti Orka") that had been designed for use with briquettes (read more about Prakti's charcoal and briquette stoves on page 22 of this Bulletin). Sensing the opportunity for a high impact partnership, ILF piloted the Prakti Orka with UNDP's paper-waste briquettes at a school in Port-au-Prince. The pilot was highly successful – the stove needed fewer than 60 of the seven-cent briquettes to cook for about 150 students – and, armed with these results, ILF was able to persuade the UN to fund a large-scale institutional stove program in Haiti.

Since that time, ILF has distributed 100 of the Prakti Orka stoves in 27 schools throughout Port-au-Prince and has laid the groundwork to distribute 510 more during the current school year. The stoves are saving schools an average of about $90 per month in fuel costs – money that can be used to pay teacher salaries or purchase much needed school supplies. At the same time, ILF's stove program has not only revitalized UNDP's briquetting program, it has caused UNDP to scale up production at its factory in Carrefour Feuilles and encouraged other stakeholders to develop additional production facilities to produce the estimated 600,000 briquettes per month that will be needed to fuel all 610 Orkas.

Finished product — briquettes made from paper, water and sawdust

The need to develop briquettes and other alternative fuel sources in Haiti could hardly be more compelling. Ninety percent of the Haitian population relies on charcoal or wood for cooking, 98% of the country has been deforested, and the average family in Port-au-Prince spends about 40% of its income on charcoal.

The existing paper-waste briquette program can play an important role in combating Haiti's reliance on charcoal, but it is only one part of what needs to be a more complete and multi-pronged approach to the nationwide fuel crisis. Given the finite amount of paper/cardboard waste and sawdust available, the room for expansion is necessarily limited. Further, owing to the use of a manual process for compressing these ingredients, they are low in density, have low energy value and are less than ideally suited for cooking. For this reason, it has proven difficult to develop a household stove that can burn them effectively.

Accordingly, part of any solution should be the development of a better quality briquette – one that has a higher density and energy value than the current paper waste version so that it will burn longer. ILF is in the process of trying to find such a briquette and is looking at bagasse (sugar cane waste), sisal (agave fiber) and other locally available materials as possible ingredients.

Ultimately, however, it is exceedingly doubtful that any form of briquette-friendly biomass can be identified that will be available in quantities sufficient to serve the cooking needs of the Haitian population. Even if it were, the reality is that the population's attachment to wood/charcoal is such that many would not be willing to make the switch to briquettes even if they were readily available. A comprehensive approach should involve the promotion of more efficient wood/charcoal burning stoves and methods of making charcoal production more sustainable. Such options might include the harvesting of trees with high regenerative growth capacity and/or using the retort method to produce charcoal, a self-contained method of charcoal production that drastically reduces biomass waste during production. Finally, to the extent practicable, efforts should be undertaken to expand the use of liquid petroleum gas ("LPG") as a viable alternative fuel.

Finished briquettes ready to be used for fuel in Haiti

In short, briquette production can play an important role in helping alleviate the fuel crisis that has stifled livelihoods and deforested the countryside throughout Haiti. However, the fastest and indeed only way of ending the Haitian cooking fuel crisis in the foreseeable future is to adopt a comprehensive, multi-pronged and complementary approach that includes briquetting, fuel-saving wood/charcoal stoves, more efficient charcoal production and LPG.

PARTNER SPOTLIGHT - The Charcoal Project

Learning by Doing: Integrating Fuels, Stoves, and Forests in Uganda

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A year ago The Charcoal Project decided that having a project on the ground would help us better understand what it takes to design and run a clean cookstove program. Our goal was to learn how cookstoves and fuels fit together.

The opportunity came when Henry Twinemasiko, the founder and director of the Rubaare Education Foundation (REF) in rural Rubaare, Uganda, contacted us and asked us to help him reduced his energy bill. Henry was concerned that the rising cost of wood fuel for the six schools he runs was seriously cutting into his overall budget. More money for fuel meant less money to spend on educating the 2000 students that attend the REF schools scattered across more than 100 square kilometers of rolling, mostly grass-covered hills.

The six schools piloting fuel briquettes in SW Uganda provide room and board to over 1600 mostly orphan and very poor children

Henry explained that the higher cost of gasoline and the limited tree cover of the region meant they had to send their aging truck farther and farther afield every two weeks to purchase wood for the network of elementary, high-school, and vocational schools he started and which today serves the poorest children and orphans in the region.

After several months of discussions we decided jointly that the way forward was to integrate cookstoves and sustainable alternative biomass fuels. We decided to call it BEEP for Biomass Energy Efficiency Program.

The 3-step approach would first target the REF schools for implementation. In its second phase, BEEP would be expanded to the community's 20,000 families. Several years down the road, in its third phase, BEEP would hopefully yield sufficient knowledge for replication elsewhere.

In practical terms, BEEP is undertaking the following steps:

1. Retrofit the school's inefficient stoves. This alone will cut down on consumption immediately. Fundraising for this phase of the project has been slow, so we have instead focused on the less expensive step 2.

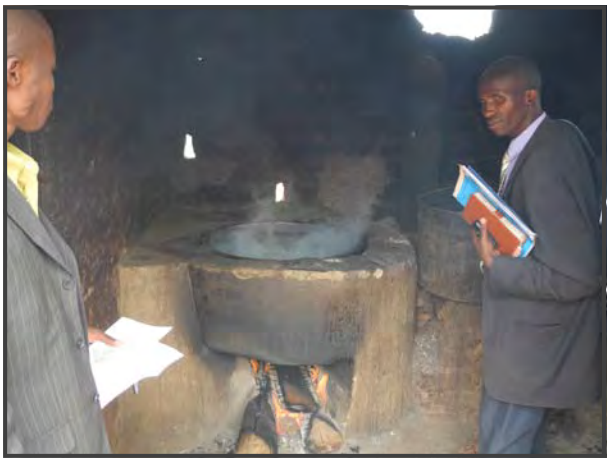
2. Use the region's abundant agricultural waste and convert it to fuel briquettes for use in the current and future stoves. We are presently in the process of training and testing the fuel briquettes in the existing stoves.

3. We have also partnered with a tree-planting non-profit that has already begun to teach the school's very engaged parent association how to plant trees as sources of fuel and additional income. The project is using tree species that are compatible with the local environment and that won't cause the displacement of indigenous species of flora and fauna.

School director, Henry Twinemasiko, oversees the production of pressed fuel briquettes made from charcoal fines, sawdust, and a binding agent

The anticipated benefits are:

1. Decreased cooking fuel costs
2. Decreased indoor air pollution exposure for the cooks
3. Income-generating opportunity for the school through the production of fuel briquettes for sale to the community
4. Entrepreneurship opportunities and improved access to affordable fuels for the larger community
5. Ecosystem restoration and sustainable forestry



REF school director Henry Twinemasiko inspects the smoky kitchen's inefficient cookstoves. These have now been retrofitted to use fuel briquettes.

The Charcoal Project is in no way the first organization to pioneer this approach. GERES' decade-old effort in Cambodia (featured in this bulletin) has been an inspiration and model for our own modest project.

Inyenyeri in neighboring Rwanda is also a fascinating project that integrates fuels and clean cookstoves with a very strong socio-economic component. In their model, Inyenyeri is employing a modified Lucia stove from WorldStove that has been tuned to burn a special recipe of locally available agricultural waste. Eric Reynolds, the founder of Inyenyeri is in the process of testing the stoves and the feedstock supply mechanism in various communities before scaling up.

Integrating alternative fuels and improved stoves may not be necessary in areas with ample fuel supply or where few choices of fuel for briquettes exist. But in places where charcoal production may be causing significant environmental damage, where wood for cooking has become scarce, or with abundant agricultural residue, it makes sense to consider sustainable alternative biomass solutions.

You can follow the progress of The Charcoal Project's BEEP program in Uganda or ask questions by visiting charcoalproject.org/projects.

Charcoal Stoves - Conversations with Testers and Developers

Charcoal Stoves Tested by U.S. EPA Laboratory

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Charcoal stoves obtained from PCIA partners were included in the last round of testing at U.S. EPA's laboratory at Research Triangle Park, North Carolina. A modified WBT (water boiling test) procedure was used for charcoal stoves, similar to a procedure used in previous testing[1], because charcoal fuel takes longer to ignite than other fuels. Charcoal stoves typically produce a large amount of smoke during startup. For this reason, stoves are typically started outdoors and are brought indoors after the charcoal is hot and stops smoking. Although the hot charcoal produces little or no visible smoke, it typically produces a large amount of CO (carbon monoxide) gas, so charcoal stoves should only be used in very well ventilated areas. CO is colorless, odorless, and can cause death. For each cold start, 45 g of a solid, charcoal igniting material was placed in the stove and then charcoal was placed around the material. The cooking pot was placed on the stove after the charcoal was ignited and the igniting material stopped flaming. During the cold start, relatively high emissions of PM (particulate matter) resulted from the ignition process. For the hot start phase of the WBT, the hot charcoal remaining from the cold start phase was weighed, and the hot charcoal was left in place in the stove. Charcoal was added if needed during the hot start phase. Emissions measured during the hot start phase included the relatively low PM emissions and relatively high CO emissions.

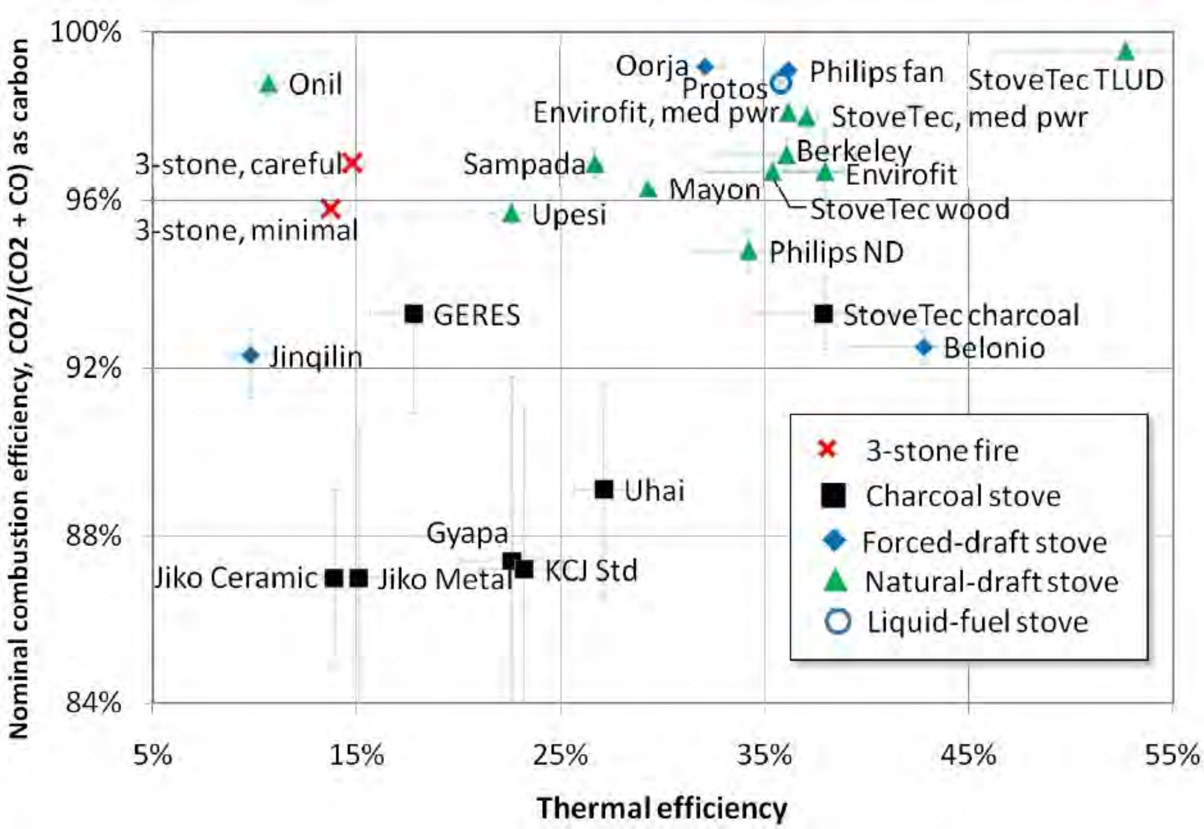
Test results are shown in the figure for the high-power (cold-start) phase of the WBT. NCE (nominal combustion efficiency) indicates how well fuel is burned (i.e., how much of the potential energy in the fuel is converted to heat energy). CO2/(CO2+CO) on a carbon basis is a reasonable proxy for NCE, and stoves with high NCE generally have low emissions of pollutants. Thermal efficiency is the ratio of desired energy delivered to the cooking pot versus net energy in the fuel. Stoves with higher thermal efficiency generally use less fuel for a given cooking task. If two different stoves have the same NCE, but one stove has higher thermal efficiency, then the stove with higher thermal efficiency will have lower emissions per task because it will use less fuel. Error bars in the figure represent plus and minus one standard deviation for the three test replications required by the WBT protocol.

Compared with the baseline, 3-stone, wood-fueled fire, charcoal stoves produced more CO and had lower NCE, as shown in the figure. For the charcoal stoves, variation in combustion efficiency was high, as indicated by the error bars, likely due to variation in the lump charcoal fuel. Lump charcoal was used for the laboratory tests, because lump charcoal is typically used in the field, and it was not uniform in size and shape. In the future, variation in test results may be reduced by screening the lump charcoal for better uniformity, although this would reduce the match to field conditions.

Compared with the 3-stone fire, the typical metal jiko and ceramic jiko charcoal stoves had similar thermal efficiency and lower NCE. Compared with the baseline, metal and ceramic jiko stoves, all charcoal stoves obtained from PCIA partners had better thermal efficiency, and some had better NCE. Among the charcoal stoves tested, the StoveTec stove had the highest thermal efficiency, likely because of a special cooking pot furnished with the stove that had an integral pot skirt and fins for improved heat transfer. Further details of EPA's last round of testing are provided on the PCIA web site: http://www.pciaonline.org/proceedings/webinar-epa-lab-test-results-household-cook-stoves

Results of testing will be published in scientific journal articles. U.S. EPA is planning to include more charcoal stoves in the next round of testing that was announced by PCIA: http://www.pciaonline.org/news/3rd-round-epa-stove-testing

[1] Jetter, J. J.; Kariher, P. Solid-fuel household cook stoves: Characterization of performance and emissions. *Biomass & Bioenergy* 2009, *33*, 294-305.



Charcoal Cooking Stoves in 2011

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Nearly 30 years ago (in 1983), Aprovecho wrote a book called "Charcoal - Small Scale Production and Use." While much of the information in the book still makes sense, there are one or two new things that add a lot to making better stoves. Two years ago, Summer Stove Camp was devoted to developing charcoal stoves for Haiti. In just one week, charcoal use in most of the stoves was halved and the 50 participants began to feel that dramatic improvements were quite possible.

After Stove Camp, Christa Roth and Christoph Messinger summarized techniques for improving charcoal stoves. They include a high turn down ratio, optimizing heat transfer, reducing losses, and using secondary air to decrease carbon monoxide. Sam Bentson and Ryan Thompson in the Aprovecho lab spent much of the last year testing fifteen charcoal stoves and we are now more confident that we have a good understanding of how to design efficient, quality improved charcoal stoves.

EcoZoom Charcoal Stove

Yesterday I tried the new stove, designed by Ryan, which is about to be manufactured by Shengzhou Stove Manufacturer and distributed by EcoZoom internationally. The stove boiled water quickly, and used around 350 grams of charcoal to boil five liters of water and simmer it for forty five minutes. Testing charcoal stoves is a pleasant change from burning wood. They take care of themselves and are similar to cooking with LPG. You light the stove and let the cooking continue without having to constantly tend the fire.

But that convenience comes with a considerable energy price tag. Turning wood into charcoal can waste 5/8ths of the energy in the wood. Wasting that much energy is hard to rationalize when thinking about fuel efficiency. On the other hand, after the stove is lit charcoal emits a lot less smoke than wood fires do. Rob Bailis has suggested that using charcoal could protect health by reducing exposure to PM by 90%. Scenarios can be imagined in which charcoal is made sustainably, but to date charcoal production continues to be problematic.

It is interesting that a majority of carbon credit projects involve charcoal stoves. The Jiko stove and the New Lao stove are generating millions of carbon reduction dollars in Africa and Asia. Developers are on the lookout for charcoal stoves that are best deals: saving the most fuel, lasting as long as possible, and costing the least amount of money. More fuel efficient charcoal stoves are attractive to projects worldwide.

How can charcoal stoves save fuel? Our testing has shown that one of the most important factors is to use the appropriate amount of fuel for the cooking task. When Sam and Ryan filled each combustion chamber, there were very large differences in fuel use to boil and simmer five liters of water. But when they used the minimum amount needed to complete the same cooking task, almost all the stoves used much less fuel and the differences in fuel use were greatly reduced.

Installing an airtight door under the grate in the combustion chamber allows the cook to slow the burn when simmering. Completely shutting the door slows the consumption of charcoal while the radiation from the top of the burning fuel continues to heat the pot above it. Once it is well lit charcoal can burn red hot for a surprisingly long time with very little air. When the surface temperature of the burning charcoal drops, opening the door can bring the temperatures back up. An added bonus is that shutting the door dramatically lowers the production of CO since the rate of burn is slowed.

Adding jets of preheated secondary air above the burning fuel provides the needed oxygen to encourage more flame and improved mixing. Flame filling the space above the burning charcoal burns up the CO that can escape if there is less flame. Adding air assists more complete combustion. The use of jets of air that fill the space above the charcoal helps to create a zone of more complete combustion.

Charcoal heats the pot mostly with radiative heat energy. Hot gases also play a large role in heat transfer. The channel gaps under and around the pot can be sized to optimize the heat transfer efficiency. Generally these channel gaps are smaller compared to wood-fired stoves. The pot can be as close to the fire as possible while creating an active zone of flame and mixing above the burn.

As Christa and Christoph suggested, the use of insulation and radiation shields decreases energy loss from the stove body. If possible, all stoves should lose as little radiative and convective heat as possible. The use of a pot skirt that creates a thinning of the boundary layer of still air next to the pot shows how much convective energy helps to heat a pot, even in a charcoal stove. Protecting the hot gases and radiative surfaces from unnecessary loss is very helpful.

We have a long way to go to completely understand charcoal stoves, but we have seen that the following techniques help considerably to cook food while using less fuel and burning up some of the escaping CO:

- Use the appropriate amount of fuel for the cooking task
- Install an airtight door under the grate in the combustion chamber
- Add jets of preheated secondary air above the burning fuel
- Size channel gaps under and around the pot to optimize heat transfer
- Use insulation and radiation shields to decrease energy loss

This kind of stove was quite successful at Stove Camp 2010. Participants tried several variations. Some of them were sized to cook food in the very large ten liter pots used in Haiti. The stove designed for Shengzhou Stove Manufacturer and EcoZoom uses about 350 grams of charcoal to boil and then simmer five liters of water in an uncovered pot for forty five minutes. CO emissions are low. These days we think of this level of performance as a benchmark for improved charcoal stoves.

In our tests, an open fire can consume around 1200 grams of wood to complete the Water Boiling Test. If charcoal was made from wood with a 50% energy loss, a charcoal stove that used 300 grams of wood would be reducing fuel use by 50%. If emissions of PM were reduced by 90%, as Rob Bailis suggests, it's not impossible that a charcoal burning stove could meet a potential 50% efficiency/90% emissions reductions benchmark if the CO was low enough.

And that's an interesting scenario to contemplate.

PCIA CARBON FINANCE WEBINARS

PCIA held the 2nd and 3rd webinars in its Gold Standard carbon finance series on October 18th and November 21st. The 2nd webinar in the series **"Innovations in Version 3 of the Gold Standard Methodology"** was attended by 64 attendees. Gold Standard Foundation's Deputy Technical Director Abhishek Goyal discussed the fundamentals of their new methodology for cookstove projects.

The 3rd webinar "**Case Studies: Gold Standard in Practice"** had 53 attendees and highlighted two successful project developers — Jimmy Tran from Impact Carbon and Dee Lawrence from Proyecto Mirador. Both shared useful lessons learned regarding stakeholder consultations and monitoring for Gold Standard carbon finance projects. Proceedings for both the 2nd and 3rd webinars in this series will be available soon at http://www.pciaonline.org/proceedings

Next webinar: Perspectives: Allocating Carbon Revenue – December 15, 2011; 10-11:30am EST
The Gold Standard and PCIA have organized this 4th and final webinar of the series to address important carbon project development choices around cookstove/carbon credit ownership, commercial distribution models, transparency, and transaction costs. The objective of the workshop is to discuss lessons learned, best practice and issues involved with the financial implementation of cookstove projects in the global carbon markets with a focus on carbon revenue allocation. This is the fourth and final webinar in a series of PCIA and The Gold Standard Foundation webinars taking place this fall as part of our efforts to increase the number of cook stove projects in the CDM, Gold Standard and voluntary carbon markets. You can register for the final carbon finance webinar through this link.

Charcoal – An Envirofit Prospective

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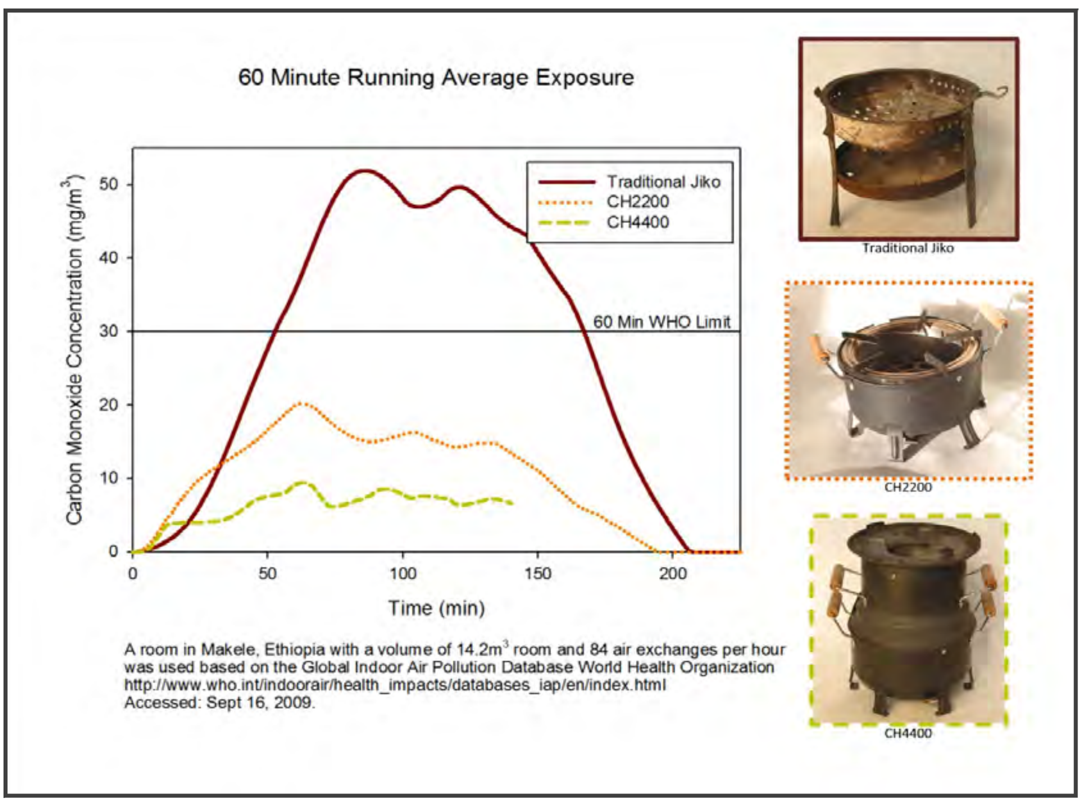
In 2011 the world has reached 7 billion people and by 2050 it is estimated to reach 9 billion. Africa is currently estimated at just fewer than 1 billion people but by 2050 it is expected to reach 2 billion, surpassing individually both China and India population estimates.[1] In Africa alone it is estimated that over 80% of the households burn biomass on a daily basis to cook their meals with a large portion using charcoal especially in urban areas where wood logistics and storage are prohibitive. The rapid expansion of population in urban areas exponentially increases charcoal consumption putting huge demands on forests as well as consumer charcoal costs.

One advantage of fully processed charcoal is that it does not produce smoke when used for cooking. Unfortunately, this means that people will sometimes use charcoal indoors or in poorly ventilated areas. This is particularly harmful since typical charcoal combustion produces carbon monoxide at a level that is much higher than conventional wood combustion. Charcoal is also preferred for its ability to produce relatively uniform heat for a long period of time, reducing the need to intensively tend a fire.

At Envirofit we see the huge need to provide quality charcoal stoves that reduce charcoal consumption thus reducing the demand for charcoal as well as saving consumers money in an already economically stressed economy. Both of our current models reduce charcoal consumption up to 60% with an 80% reduction in emissions. Both utilize the same patent pending metal alloy that we developed for our G3300 wood burning stove and carry the same 5 year combustion chamber warranty. Using this low cost durable metal allows us to design the chamber with features that cannot be done with ceramic chambers. By enclosing a majority of the chamber some of the heat radiated from the charcoal is reflected back onto the coal bed. This reflected heat ("inverse suntan" as we like to refer to it) rapidly increases the temperature of the charcoal which not only increases the amount of heat that is transferred to the pot leading to dramatically lower fuel use, but also *destroys virtually all of the carbon monoxide* that would be seen in a typical charcoal stove. This significant reduction allows our charcoal stove to meet the Shell Foundation Benchmarks for carbon monoxide as well as the World Health Organization carbon monoxide 60 minute exposure limits under typical conditions.[2] To our knowledge this is the first charcoal stove that has been capable of doing this.



A room in Makele, Ethiopia with a volume of 14.2m³ room and 84 air exchanges per hour was used based on the Global Indoor Air Pollution Database World Health Organization http://www.who.int/indoorair/health_impacts/databases_iap/en/index.html Accessed: Sept 16, 2009.

Our work on charcoal is just the beginning as we are also working on new advances in charcoal stoves as well as highly efficient kilns and utilization of alternative biomass sources and briquettes. Charcoal is an excellent fuel in many respects but when charcoal is produced using typical production techniques, it is one of the most wasteful ways to cook food from a total efficiency perspective with only a small fraction of the useful energy from the wood ever making it to the pot. We see high efficiency kilns as the beginning of the process in helping establish renewable forest projects. Highly efficient charcoal stoves along with highly efficient charcoal kilns coupled with alternative biomass and briquetting can take enormous pressure off the wood demands of the forests and keep fuel prices to consumers as low as possible.

Envirofit CH2200 stove

Envirofit CH2200 stove with grill adapter

As we begin our production of stoves (wood and charcoal) at our Kenya factory in early 2012 we will also be launching a third charcoal stove to our lineup, the CH5200 a slightly larger version of our CH2200. This is just the beginning of more to come in our continually evolving line of Envirofit Clean Technology Cookstove products and additional manufacturing centers not only in Kenya serving East Africa but also in Nigeria and Ghana serving West Africa.

[1] United Nations populations estimates.
[2] Air Quality Guidelines for Europe, 2nd Edition. World Health Organization Regional Office for Europe, Copenhagen, 2000. http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf

Charcoal and Briquette Stoves – Current Innovations from Prakti Design

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Like many social enterprises working on stoves, Prakti started focusing on wood stoves. This was a major limitation when we started working in Haiti. Haiti has the double challenge of using charcoal as the primary cooking fuel (urban and semi-urban), and being roughly 98% deforested. After the earthquake, we set our priority to develop an institutional briquette stove for refugee camps, schools, and restaurants. We developed a briquettes combustion technology in February 2010. Six months later, we hand carried our first briquette institutional stove to Haiti. Now, there are over 500 Prakti institutional stoves in Haiti, serving over 100,000 meals per day. With these stoves, we created enough demand to exceed the production capacity of the only briquettes factory in Haiti and a second factory is planned. We also developed a concept for a household version of the briquettes stove and we are seeking investments to support its R&D, production tooling, and distribution setup.

Prakti institutional stove durability testing

In the case of Haiti, charcoal is a fuel deeply engrained in Haitian kitchens, from both a cultural and fuel distribution infrastructure point of view. It was clear that a modern and improved charcoal stove would have a huge social impact. We shipped our first Prakti-charcoal stove to Haiti in July 2010. Today, there are over 2000 Prakti-charcoal stoves in Haiti. The monitoring and evaluation done by International Lifeline Fund on both Prakti-institutional and Prakti-charcoal stoves were very positive. We are currently seeking investors to setup local production and commercial distribution of stoves in Haiti.

Prakti household charcoal stove

We realize that charcoal is also engrained in most urban and semi-urban markets in Africa. Paradigm Kenya completed six focus groups in Kenya and like Haitian cooks, they found that Kenyan cooks prefer Prakti stoves over traditional stoves and other improved charcoal stoves.

400 Prakti Orka stoves ready for distribution

There is huge potential for sustainable growth and social impact by developing stoves for alternative fuels such a briquettes, and by improving stoves using traditional fuels such as charcoal.

Sustainable Charcoal - Production and R&D

Improving Traditional Charcoaling

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Charcoaling is the process used to concentrate the carbon, and obtain a fuel that has a higher caloric value than wood (7500 Kcal/kg for charcoal, versus 4700 Kcal/kg for wood).[1] While wood composition is made up of approximately 50% carbon , 43% oxygen, 6% hydrogen and less than 1% inorganic elements; charcoal, on the other hand, as the main product of slow pyrolysis, is made up of about 75% carbon, 24% inorganic volatile composts, and 1% ash.[2] Charcoal is also lightweight, which makes it easier to handle, transport, and store than firewood. In addition, unlike firewood, charcoal is free of most (volatile) smoke.

Charcoaling, as it is commonly done in the developing world to produce lump charcoal for the cooking market, is also known as slow pyrolysis, which is a thermochemical process used to decompose wood at elevated temperatures (around 450°C), in an oxygen-starved environment, for five to seven days.

Wood charcoaling involves five phases in the pyrolysis process:

- In phase I (under 200° Celsius), the wood undergoes a drying process, thereby losing its water content.
- It is then followed by torrefaction or phase II (between 200° and 280° Celsius), in which the wood loses nearly all its water and some of the non-condensable gases[3], some of which are flammable.
- Phase III is the initial pyrolysis phase (between 280° and 380° Celsius), where non-condensable and condensable gases (tar) are almost fully released from the wood, and it becomes charcoal at the end of this phase.
- Phase IV is the final pyrolysis phase (between 380° and 500° Celsius), with carbon fixing, where all non-condensable and condensable gases are finally released with heavy tar, and the carbon content of the charcoal reaches its highest level.
- Phase V is the cooling down period, in which the temperature inside the kiln drops down to about 40°C, so that the kiln can be opened. This cooling phase may take several days.

Generally, when charcoal is produced in kilns with an efficiency of approximately 30% (based on mass), nearly half the original wood energy is lost through smoke and the production process, while the remainder of the energy is retained in the charcoal itself. However, in most of sub-Saharan Africa, traditional kilns are only 18% efficient (based on mass) and 2/3 of wood energy is lost. The result of this inefficient charcoal production is that it puts more pressure on the remaining natural forest of the region, requiring substantially more wood per ton of charcoal produced than is necessary.

To improve charcoal productivity and reduce pressure on forest resources in Africa, the charcoaling process needs to be improved. The factors that most influence the charcoaling productivity are the quality of wood and the carbonization process. Wood with less humidity, higher density and diameter between 10 and 20 cm are preferable, while the carbonization process with limited maximum temperature (400° to 450° Celsius), controlled air exchange, and lower energy losses, also significantly contributes to increasing efficiency and making better quality charcoal.

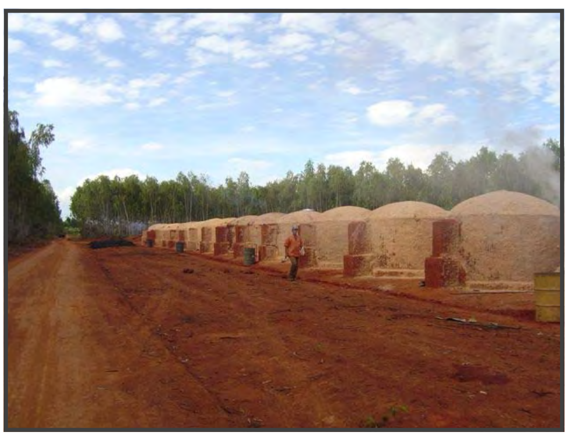
Photo credit Paulo Cesar C. Pinheiro

Improved charcoal kilns in Brazil made of low cost ceramic bricks

An example of good performing kilns to make charcoal are the brick kilns (igloo type) that are made with local low cost materials, and are designed to make operations easier, such as loading and unloading, controls of air exchange and temperature (even possible with thermometer), and to speed up cooling with *barrela* (a watery mud mix that is sprinkled over the kiln). Such kilns have costs varying between US$150 and US$500 each, depending on size, but can achieve yields from 30 to 35% in weight. [4]

Furthermore, these kilns can be disassembled, transported, and reassembled by trained people. Charcoal production techniques have been further modernized in some countries, like in Europe and parts of Brazil, with more sophisticated industrial charcoal production plants that avoid the emissions of greenhouse gases and other pollutants, and even allow cogeneration of power and/or heat (see article on page 26 of this Bulletin). However, for more traditional charcoal producers, like those in Africa for instance, an intermediate step toward modernization should be improvement of traditional kilns, to achieve the highest possible efficiency with affordable and accessible technologies.

1Cardoso, Marco Túlio, Dissertação *Magister Scientiae*. Desempenho de um Sistema de Forno-Fornalha para Combustão de Gases na Carbonização de Madeira. UFV, Viçosa, Brasil, 2010.

2 Brito, Prof. José Otavio. Principios de Produção e Utilização de Carvão Vegetal de Madeira. Universidade de São Paulo, Escola Superior de Agricultura Luiz de Queiroz, Departamento de Ciências Florestais. Documentos Florestais. *Piracicaba* 1990, 9, 1 –19, Maio.

3 During wood pyrolysis, the exhaust gases are formed by two portions: condensable (CO_2, CO, H_2, CH_4 and other hydrocarbons), and non-condensable (methanol, acetic acid, H_2O, polycyclic aromatic hydrocarbons, and tar).

4Producão de Carvão Vegetal No Brasil. Seminario “Encuentro Regional sobre Biocombustibles y Energias Renovables”23 de Abril de 2009, UDELAR, Montevideo, Uruguay. Prof. Paulo Cesar C. Pinheiro, Dept. Engenharia Mecânica da UFMG.

Charcoal Production and Livelihoods: Understanding the Issues in a Semi-Arid Area in India[1]

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Introduction

Charcoal production in many developing countries is complex, as it links livelihoods and income generation with social, economic and environmental issues. Due to increases in the price of the petroleum products, there has been a huge increase in demand for charcoal. In parts of India in the last year alone, the price of charcoal has doubled.[2]

Who produces charcoal and why?

In rural areas apart from involvement in agricultural activities, some people are also engaged in charcoal production. The majority of people involved in charcoal production in India are from semi-arid areas, because agricultural activity alone is not sustainable, due to increasing populations, reduced size of land holdings, fragmentation of lands, non-sustainable agricultural activity, existing policies, etc. Recently, biomass energy has become a commodity in rural areas too. People sell wood directly for various purposes and charcoal is one of the value added products that is a very profitable source of income.

A charcoal producer harvesting the charcoal carefully (involves quenching the burning charcoal pieces with water)

How charcoal is produced?

There are various sources of biomass for charcoal production in India - local trees, exotic species like Prosopis Juliflora and crop residue. Traditionally people have been using inefficient earth mound kilns for charcoal production and they are not aware of any efficient charcoal production technologies.

Mostly middle-aged men and women are involved in charcoal production activity and many of them have only recently been trained in charcoal production. The majority of the community members involved in this activity are poor, representing schedule castes[3] and backward communities. Per batch on an average they produce 7000 kgs of charcoal and on a small scale about 3500 kgs. About one and half to two months of time is spent per batch of charcoal including the time required to produce charcoal in earth mound kilns (about 10 to 15 days), time spent on harvesting the wood, transportation and preparation of mounds, etc. The yield of charcoal is around 25% by weight when Prosopis Juliflora wood is used. Due to accidental fires / excess air entering during the production process, the yield could be even less than 25%. Profit earned per batch of charcoal produced ranges from 25% to 100% on the investment.

Women play an active role in charcoal production, since they are involved in harvesting the wood, processing, cutting into smaller sizes and laying the wood in kilns, monitoring the kilns, fetching water for quenching the burning charcoals and extracting charcoal from the kilns.

A couple involved in charcoal production in Peddamaduru Village, Devaruppala Mandal, Warangal District, India

Conclusion

Prosopis Juliflora, crop residue, and other biomass are the main sources of biomass available for charcoal production. Prosopis Juliflora is found in fallow lands, degraded soils, alkaline soils, road margins, stream / tank beds, etc. Under ongoing rural development programs, such as employment guarantee schemes and land development programs, the Prosopis Juliflora and other biomass are uprooted. There are currently not very many programs for sustainable management of biomass as an energy source. Charcoal production is becoming an important emerging livelihoods activity in rural areas, with limited and non-sustainable biomass sources, a current lack of available efficient technologies for charcoal production and no real organized / institutional marketing systems. All these factors threaten the viability of this important livelihood activity.

There are several difficulties in charcoal production. In earth mound kilns the challenge is continuous monitoring for efficient charcoal production. If not monitored well, the charcoal producers face losses due to conversion of charcoal into ash by excess combustion. The availability of water is an important requisite for charcoal production, to control excess fire as well as for quenching embers while extracting the charcoal. During production and handling of charcoal the smoke and charcoal dust could lead to respiratory problems. Cutting wood like Prosopis Julifora presents safety risks from thorns. There are agents / brokers between the primary producers and wholesale dealers, who get most of the profits. There is a need to unite charcoal producers as cooperative groups for collective use of resources, access to efficient charcoal production technologies, management of biomass, ownership of licenses for production and sales, collective marketing and negotiating for a better price, having insurance from accidental losses of charcoal during production processes, access to loans from formal institutions, insurance for people involved in charcoal production, etc. Some of the charcoal produced is even being sold in markets nearly 1000 kms away.

Earth Mound Kiln in Peddamaduru Village, Devaruppala Mandal, Warangal District, India

Role of GEO

Geoecology Energy Organisation [GEO] has designed 5 low-cost charcoal production technologies / methods. GEO is also supporting traditional charcoal producers with access to these efficient low cost charcoal production technologies. Apart from use of biomass for soil carbon, GEO is also encouraging production of charcoal from crop residue and exotic and invasive species of plants like Prosopis Juliflora and Lantana. As part of GEO's policy and advocacy work, we are working with government agencies and organizations to recognize charcoal and biomass as energy commodities which can provide additional livelihoods opportunities for communities through effective management of biomass. In its ongoing programs, GEO is exploring various possibilities for addressing the above mentioned issues related to charcoal production.

GEO is also involved in biochar compost production and facilitation to the farmers (charcoal plus amendments for better soil management). The application of biochar has resulted in 150% to 200% increase in crop production. GEO is one of the first organizations in India to introduce and do studies on Biochar in India. GEO has also designed 50 low cost and highly efficient good stoves, being disseminated throughout India, including domestic and institutional stoves. GEO's highly efficient gasifier (TLUD / woodgas) stoves, Hybrid stoves, 3G stoves, etc. are all designed using locally available material and scientific principles. GEO also works on programs related to water resources, sanitation, disaster mitigation and response, and ICTs. For more information on GEO's program areas, please visit http://e-geo.org

GEO is presently implementing a research-based program integrating the above themes, which is called the Good Stove and Biochar Communities Project, with the support of goodplanet.org, based in France.

[1]This article is prepared based on the field observations in semi-arid parts of Warangal and Mahabubnagar District, Andhra Pradesh, India.
[2]The retail price of charcoal current price is Rs. 24 per kg in Hyderabad, Andhra Pradesh, India.
[3]Scheduled Castes are the historically disadvantaged people who are given recognition in the Constitution of India. And Backward castes are also known as other backward castes (OBC), recognized by the central and state governments represents castes and communities based on backwardness of Social, Educational and Economic factors.

Hope for Modernizing Charcoaling in Africa, with Cogeneration of Power

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Anyone who has witnessed traditional charcoal-making has probably noticed the large amounts of gray, blue, and white smoke that billow from the old-fashioned kilns. The smoke that emanates from these low-efficiency kilns contains black carbon, particulate matter, and various greenhouse gases. What few people realize is that smoke also contains substantial amounts of energy. In fact, we know that in more efficient charcoal production systems, with 30% or better performance, nearly 1/2 of the original wood energy ends up as charcoal, while the other half is still wasted through the smoke. In more traditional production systems, like those seen in much of Africa, the wasted energy can be as high as 2/3 of the original wood energy.

In much of the developing world, including in parts of Brazil and sub-Saharan Africa, the smoke (pyrolysis gases) from charcoaling is released into the atmosphere, while in the developed world, such as in Europe and the US, charcoal producers are regulated to at least flare such gases (a process that burns up excess gases) to avoid pollution. By flaring the flammable gases from the pyrolysis (condensable and non-condensable gases) in a more efficient charcoal production system, an additional 1/3 of the original wood energy can be tapped and transformed into useful energy to generate heat and/or electricity. The remaining difference (1/6 of the original wood energy) represents the energy losses of the charcoaling system.

Photo credit Rogério C. Miranda

Traditional charcoal kilns in Madagascar, with nearly 2/3 of energy losses through the smoke

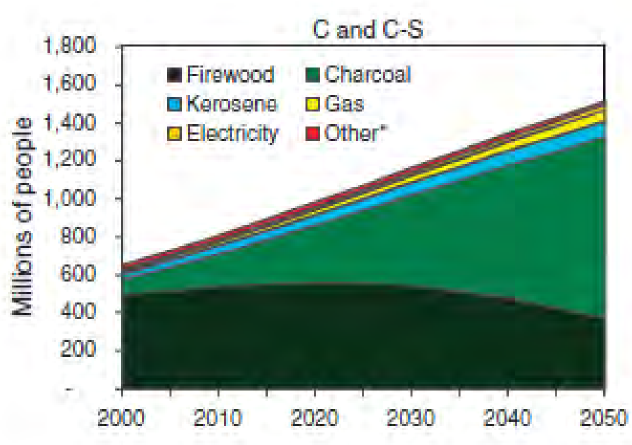
Indeed the potential for cogeneration per ton of charcoal produced is enormous, considering that 1/3 of the original energy from 3.3 tons of air-dried wood (which is roughly the amount of wood needed to produce 1 ton of charcoal), is about 5.2 million Kilocalories. With that amount of energy, about 6,000 Kilowatts of thermal energy can be produced, and from that at least 500 KW of electricity can be generated.

According to FAO's estimates, 25 million tons of charcoal were consumed in sub-Saharan Africa in 2009. This means that the potential electricity that could be generated from wasted charcoaling smoke was about 12.5 Terawatts per year, which is double Kenya's power consumption in 2008.[1] This is a not a small thing, since to generate all this energy would require a power plant with capacity equivalent to 1,500 Megawatts operating for 8,000 hours.

The technology to cogenerate electricity from charcoal smoke is not commercially mature yet, but it's fast developing in Europe and Brazil. This practice did not exist before given that there was no need to generate electricity, since power from the grid was commonly available among industrial producers. Additionally, there were no attractive market incentives for power cogeneration from charcoaling. However, nowadays, concerns about climate change are transforming this situation, as modern charcoal producers want to burn the smoke and capitalize on carbon credits, promoting themselves as using cleaner production methods. The growing interest and investment in self-consumption, decentralized and mini-grid power systems provides additional incentives for the development of this technology.

It is possible to envision that in the future, charcoal producers could cogenerate enough power in rural areas to meet the need of rural communities, which is where most of the charcoaling activity takes places and which tend to be cut off from national electric grids.

The ongoing trends in population growth, urbanization,[2] persistent poverty,[3] and volatile markets for alternative fossil fuels for cooking are expected to lead to a doubling of the current demand for charcoal over the next two decades.[4] Unless new policies are implemented, the number of people without access to electricity is predicted by the International Energy Agency (IEA) to rise in Africa through 2030 by 10,4% (from 585 million in 2009 to 646 million in 2030).



The number of people using charcoal as main cooking fuel in Sub-Saharan Africa could well double by 2030.[5]

Key: Charcoal (C) and Sustainable Charcoal (C-S)

Given this outlook, sub-Saharan Africa could greatly benefit from this emerging co-generation technology. However, to cogenerate power, charcoal producers in sub-Saharan Africa will need a new business model, with greater charcoal production capacity, certified sustainable forestry, professional business management, and perhaps clustering into community charcoal production centers.

There is an urgent need to modernize charcoal production in Africa, and such technology could provide key incentives for modernization. Local governments and the international community should support the necessary R&D for the adaptation of charcoal cogeneration to African conditions.

1Key World Energy Statistics, International Energy Agency. Paris, France. 2010 http://www.iea.org/textbase/nppdf/free/2010/key_stats_2010.pdf
[2]World Population Prospects: The 2002 Revision. The United Nations. Population Division of the Department of Economic and Social Affairs of the UN Secretariat, 2004.
[3]African Economic Outlook 2011, OECD
[4]Bailis, Ezzati, Kammen. Mortality and Greenhouse Gas Impacts of Biomass and Petroleum Energy Futures in Africa. *Science*, 1 April, 2005, 308.
[5]Bailis, Ezzati, Kammen. Mortality and Greenhouse Gas Impacts of Biomass and Petroleum Energy Futures in Africa. *Science*, 1 April, 2005, 308.

An Update on Charcoal R&D from the Engines and Energy Conversion Laboratory at Colorado State University

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Charcoal in Haiti is a very serious concern. Approximately ninety eight percent of the land has been deforested, largely due to the inefficient production and use of charcoal in traditional pits and stoves respectively. The vast majority of Haiti's citizens use charcoal as their sole fuel for cooking.

CSU's Engines and Energy Conversion laboratory is attempting to improve the situation by developing a modular charcoal production system that greatly increases the fuel conversion efficiency, from the abysmal baseline of ten to twelve percent; that is to say that ten trees result in one tree worth of energy.

Retort system at Colorado State University Engines and Energy Conservation Lab

The system that is being developed and tested at the EECL takes advantage of the retort process, in which heat that is released during the exothermic stage of pyrolysis is utilized to perpetuate the conversion of wood to charcoal. This has been shown in the literature to result in doubling or tripling of conversion efficiency when compared to pit style production, but has yet to come to a widely adoptable form. The retort system will allow for multiple units to be used in series for a wide range of charcoal production scales.

Closer look inside the retort system

While this project is being supervised by researchers (Willson, Kreutzer) and graduate students (Prapas) at the EECL, a team of undergraduate seniors is carrying out much of the work through CSU's Senior Design course; a two semester course in which seniors are tasked with a major design problem and the deliverables that come along with such a project. This presents a unique opportunity for students and professors to work together on a problem with potential for large impact.

Aside from the Haiti retort project, there are several other R&D projects related to charcoal currently going on at the EECL including:

Charcoal Chemical Kinetics: Numerical and experimental work has been occurring at the EECL seeking to better understand the chemical processes that are occurring inside a charcoal stove. This work is shedding new light not only on how charcoal reacts but on what is needed in order to design a stove which maximizes fuel economy while minimizing the release of harmful emissions.

Charcoal Stove Design: The EECL has a long history of charcoal stove design and testing. In the past 18 months over 550 hours of charcoal stove testing has been conducted. The stove development process has resulted in a suite of stove designs which are capable of improving fuel efficiency by as much as 62% and carbon monoxide emissions by 80% over traditional designs.

Health Effects of Biomass Combustion Emissions: A team from the Environmental & Radiological Health Sciences at Colorado State University has developed a new instrument capable of exposing human lung cells to combustion emissions, which has been used to evaluate a range of biomass cook stove designs at the EECL. The advent of instrumentation like this will allow for preliminary evaluation on the health effects of stove designs in the laboratory, a process which until now has been riddled with obstacles and limitations.

Sustainable Charcoal Initiative to Boost Deployment of Clean Cookstoves: Turning Charcoal into a Modern Renewable Fuel for Africa

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As has been shown throughout this Bulletin, current patterns of charcoal production and consumption in many parts of sub-Saharan Africa are inefficient and not sustainable over the long run. This results in significant environmental, social, and economic problems.

What is the Sustainable Charcoal Initiative?
The Sustainable Charcoal Initiative (SCI) seeks to turn charcoal into a modern renewable fuel that supports low-carbon economic growth and delivers domestic and productive energy security to sub-Saharan Africa. **Clean cookstoves that burn charcoal and/or fuel-briquettes efficiently are an integral part of the SCI's effort to bring efficiency across the entirety of the biomass energy supply chain.**

What is Sustainable Charcoal?
There is no simple definition for sustainable charcoal as geographies and timeframes must first be defined. Yet, at its core, sustainable charcoal is the application of sound forest management practices coupled with the use of energy efficient and GHG-reducing technologies for the production of charcoal. The production and consumption of sustainable charcoal also delivers value to producers, end-users, and society at large.

Sustainable Charcoal also includes the production and consumption of alternative solid biomass fuels, such as fuel briquettes, made from discarded agricultural waste and or wood industry residues.

- Under the right conditions, sustainable charcoal can deliver:
- Secure domestic energy for national economic growth
- Significant revenue to national finances
- Employment and economic development, especially in rural areas
- Significant reduction of greenhouse gas emissions
- The energy necessary for electricity generation
- A tool for biodiversity conservation
- The foundation for a sustainable forestry industry
- A mechanism for climate change mitigation and adaptation

Who is behind the Sustainable Charcoal Initiative?
In June 2011, **The Charcoal Project** and its partners, with support from the Swiss Development & Cooperation

Agency (SDC), brought together energy producers, conservation organizations, multi-lateral and development institutions in Arusha, Tanzania, to identify the steps necessary to transition sub-Saharan Africa towards the use of sustainable charcoal. The outcome was a white paper that makes the case for turning charcoal into a modern renewable fuel for sub-Saharan Africa. The paper lays the foundation for the launch of the Sustainable Charcoal Initiative.

It's important to note that the supporters of the SCI do not view charcoal as a preferred fuel for cooking over LPG, ethanol, or other more modern cooking fuels.
Instead, the SCI understands that, under a business as usual scenario, charcoal production and consumption in sub-Saharan Africa is set to double by 2030. The Sustainable Charcoal Working Group believes that, until socio-economic development reaches a tipping point, charcoal will remain the fuel of choice for most of the poorest citizens in the region for decades to come.

What does the white paper conclude?

The economic reality is that Africa will inevitably continue to consume enormous quantities of charcoal for the foreseeable future. It is therefore important that the governments of Africa begin considering practical, long-term solutions to the growing demand.

Given the charcoal sector's robust economic impact on national economies, proactive policies can result in the implementation of sustainable forestry practices that deliver low-carbon economic growth and spur the growth of a new energy economy centered on sustainable forestry industry, clean burning technology, and renewable fuels.

Significant policy reforms must occur to create the environment necessary for the growth of a sustainable charcoal industry at national and regional level.

What are the next steps for the Sustainable Charcoal Initiative?

The SCI will be a private-public partnership that will operate over several decades to achieve its goal. The SCI will be launched at an International Conference on Charcoal in 2012.

For more information, please contact
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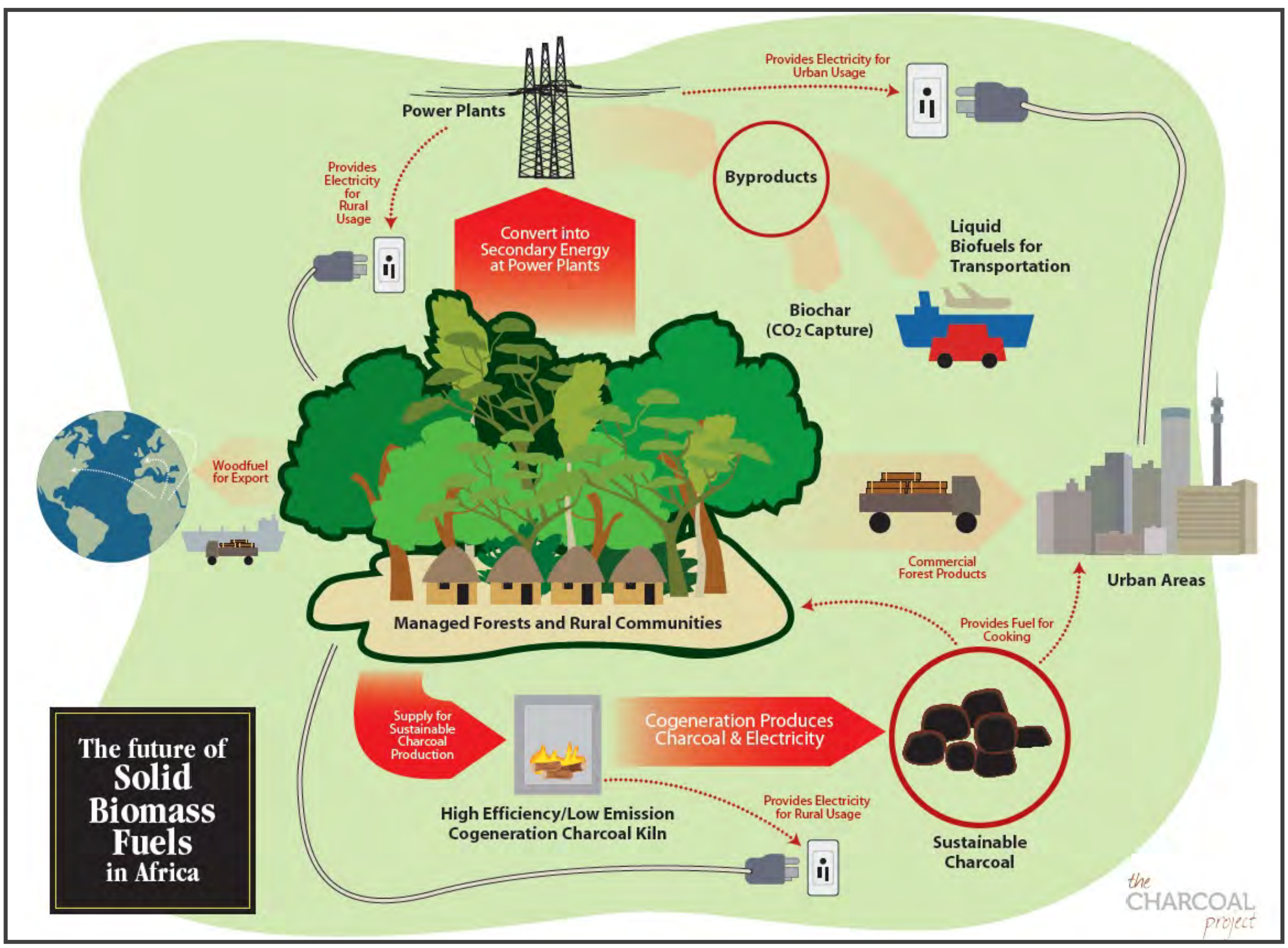

RECENT PARTNER ACTIVITY

Increased Capacity at Shengzhou Stove Manufacturer in China

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Mr. and Mrs. Shen have spent the last few years making huge improvements at their stove factory. They started by installing new more powerful equipment to mix the clay, and extrude the ceramic combustion chambers. A 45,000 capacity dryer coupled to the 200 by 100 foot sawdust fired kiln has resulted in much quicker and more reliable drying. All combustion chambers are cut to shape so sizing is controlled.

The Shens built three 1,500 square meter buildings where assembly and shipping occur. A month ago they installed a 50 person assembly line that features pneumatic tools at each station, good lighting, electric winches to position the work, and turntables where traveling pallets can be adjusted as needed. Stoves are now finished at the rate of about one a minute! An automatic strapping machine finishes the stove packaging which then can move directly into the 20'or 40' shipping containers on trucks inside the building.

Aprovecho Research Center does the stove designing and testing for the factory. There is a lab at the factory with state of the art emission testing equipment. For their part, the manufacturing experts at the Shengzhou Stove Manufacturer are increasing their capacity to make millions of highest quality, affordable stoves every year. For more info see: www.aprovecho.org

Uganda Liquefied Petroleum Gas Association Holds LPG: Exceptional Energy for Uganda Conference

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On July 8th 2011, Uganda Liquefied Petroleum Gas Association (ULPGAS), held its first ever conference on LPG: Exceptional Energy for Uganda. The conference was attended by representatives from World LP Gas Association, government officials from Ministry of Energy, Uganda Bureau of Standards, Uganda Investment Authority and Ministry of Health and Donor Agencies; World Health Organisation, World Bank, and UNDP. ULPGAS feels that LPG is an exceptional fuel for Uganda because it is affordable, reliable and readily available, especially since Uganda has its own discoveries. It is anticipated that within five years Uganda will be extracting its own LPG, improving on its reliability and affordability.

Michael Kelly (WLPGA), Renzo BEE (TotalGaz international, Rev. Frank Tukwasibwe (Ministry of Energy and Mineral Development)

The conference participants heard that while affordability and availability of LPG are significant issues that are currently inhibiting the uptake of LPG by low-income households, the biggest barrier is fear. Although this fear is based on unfounded rumors and hearsay, the fear itself is genuine. Many people report that they perceive an LPG cylinder as 'a bomb waiting to go off'. Until the fear of LPG can be overcome, efforts to improve the affordability and availability of LPG will not result in significant uptake.

Over 90% of Ugandans use fuelwood as a source of energy for cooking and less than 1% use LPG. During the conference, it was revealed that if this current trend is not checked, Uganda will lose about 50% of its forests, having an immense effect on water levels leading to increased famine. It was also reported that the LPG industry players in Uganda are planning to improve the distribution of LPG in rural and peri urban areas to people who are most affected by the use of traditional biomass fuels for energy. The effects of indoor air pollution on child mortality and morbidity as well as pneumonia and related illnesses in women were discussed, and LPG was considered as one of the options to address these negative health effects.

ULPGAS has positioned itself as a non-profit organization seeking to advance LPG as a source of alternative and clean energy that will keep Ugandans healthier by eliminating the negative impacts of traditional fuels on the health of Ugandans. Among the objectives of ULPGAS is to create awareness of LPG in peri-urban and rural areas households with an intention of reaching 20% of the population by 2020.

Learn more about PCIA Partners' efforts to promote LPG in PCIA Bulletin #26 http://www.pciaonline.org/bulletin/pcia-bulletin-issue-26

USAID TRAction Project Announces Grant Awardees

The United States Agency for International Development (USAID), through the Translating Research into Action (TRAction) Project, recently announced three new grants to PCIA Partner Impact Carbon, Duke University (with team members Scripps Institution of Oceanography and TERI) and PATH (with team members Berkeley Air Monitoring Group, CREEC and JEEP). The grants are for investigating the factors that enable families to purchase improved low-emission cookstoves and use them correctly.

The studies will develop and implement innovative behavior change interventions to promote improved stove acquisition and correct use in India and Uganda. Congratulations to the awardees!

2011 PCIA RESULTS REPORTING

The 2011 PCIA Results Reporting will begin mid-January 2012. Please be prepared to submit 2011 results for your organization including number of stoves sold by country! We have an ambitious but achievable **goal of 300 Partners reporting** this year.

These results help us highlight the amazing work done by our Partners each year and to plan future PCIA and Global Alliance activities. Check the PCIA website in the coming weeks for more information and a list of prizes for early responders!

Breakthrough Progress on Road to Developing Stove Performance Standards

Building on the momentum generated over the past year by our household energy community to develop cookstove standards, the Partnership for Clean Indoor Air (PCIA) and the Global Alliance for Clean Cookstoves (Alliance) worked with the American National Standard Institute to submit a proposal to the International Standards Organization (ISO) seeking to hold an "International Workshop" with the goal of developing an International Workshop Agreement (IWA), a interim, voluntary, consensus document that can be widely used by stove organizations and country governments while we embark on the longer (18 to 36 month) process for development of a full ISO standard. The ISO Technical Management Board unanimously approved the proposal and we are preparing for the International Workshop at the end of February/early March (dates and location will be announced soon).

An International Workshop Agreement is an ISO document produced through workshop meeting(s) and not through the technical committee process. The benefit of developing an IWA is that it can be developed swiftly [to address a rapidly emerging market need or public policy requirement]; the ISO brand gives international recognition and credibility to a community's work; and IWAs can be used as precursors to international standards. Developing internationally recognized standards that are widely accepted by the stove community and adopted by country governments could spur wider adoption of clean cookstoves in a number of ways, including defining for users, stove makers, and policy makers what constitutes an "improved cookstove" in terms of fuel use/efficiency, emissions and safety, and over time durability, while allowing for differences in local conditions and user behavior.

An International Workshop, as all ISO activities are, is an inclusive workshop. ISO invites all ISO Members (standards setting organizations) and relevant community stakeholders. PCIA and the Alliance will provide a limited number of travel scholarships to Partner organization representatives to ensure that the workshop includes a wide range of cookstove stakeholders [including stove manufacturers, implementers, researchers, academics, stove testers, and other cookstove community members] from around the globe.

The voluntary, interim cookstove document that we plan to finalize through the IWA will be based on the Lima Consensus "Tiers of Performance." You can read more on the Lima Consensus in PCIA Bulletin #27 at http://www.pciaonline.org/files/PCIA-Bulletin-Issue-27.pdf. Over the next twelve weeks, we will be soliciting input from the cookstove community on how tiers of performance might be developed, how they would work in practice, and how they might drive innovation in stove performance. Look for updates on the IWA, including logistical information, such as the date and location, information on how to apply for travel scholarships, and opportunities to provide input on developing and then implementing "Tiers of Performance." For more information on the IWA, contact moderator@pciaonline.org.

PCIA WEB RESOURCES

Be sure to check out these resources available on the PCIA website:

- Use the Partner Search to learn about and connect with other Partners
- Visit the Interactive Map to search by Partner Countries of Operation
- Watch videos to learn more about PCIA Partners
- View Presentations from a PCIA Event on the Proceedings page

UPCOMING EVENTS AND ANNOUNCEMENTS

2012 ETHOS Conference, Kirkland, Washington, January 27-29th, 2012

The 2012 ETHOS Conference will be held in Kirkland, Washington, from Friday, January 27 to Sunday, January 29, 2012. The 2012 ETHOS Conference aims to expand its reach from previous annual meetings, encouraging participation of southern Partners, international stoves experts, and development specialists with field experience in the transfer of cooking technologies. For more information and to register, see: http://www.vrac.iastate.edu/ethos/conference.php.

We value your feedback on what information would be most useful and interesting for you to receive through the Bulletin.

Send your proposed topics and contributions (including upcoming events and announcements) to moderator@PCIAonline.org

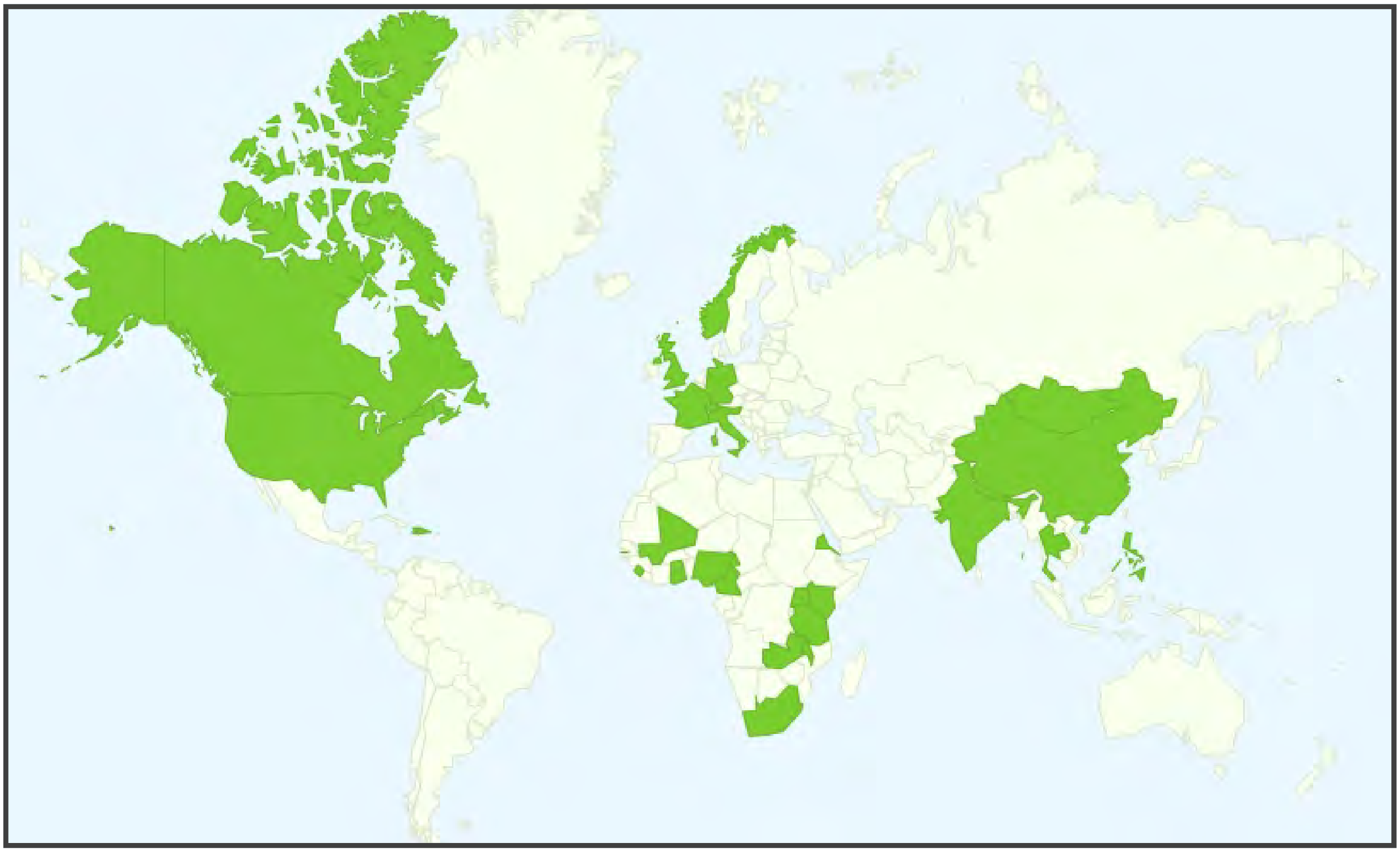
Congratulations Nancy Hughes and StoveTeam International

Nancy Hughes was recently selected as one of five people to win the 2011 Purpose Prize. Since 2007, StoveTeam International has helped entrepreneurs in developing countries manufacture and sell the affordable Ecocina stove. The Ecocina stove has replaced the traditional open cooking fire in more than 15,000 homes across Central America, reaching over 90,000 people.

Watch the Purpose Prize video and find out more about StoveTeam International at http://www.stoveteam.org. You can view StoveTeam's Partner Profile at http://www.pciaonline.org/stoveteam-international

CHARCOAL AND BRIQUETTES FACT BOX

AT LEAST 107 PCIA PARTNERS BASED IN 34 COUNTRIES ARE WORKING ON CHARCOAL AND/OR BRIQUETTES INITIATIVES WORLDWIDE



- Cambodia
- Cameroon
- Canada
- China
- Congo, The Democratic Republic
- Dominican Republic
- Eritrea
- France
- Gambia
- Germany
- Ghana
- Haiti
- India
- Italy
- Kenya
- Malawi
- Mali
- Mongolia
- Nepal
- Nigeria
- Norway
- Philippines
- Republic of Korea
- Sierra Leone
- Slovenia
- South Africa
- Swaziland
- Switzerland
- Tanzania
- Thailand
- Uganda
- United Kingdom
- United States
- Zambia