

Improving lives and the environment in the developing world through clean-burning biomass stoves

Cooking up a solution

Many stove manufacturers worldwide currently build and distribute biomass-fuelled cookstoves, but the problem of producing a clean, efficient, and affordable cookstove that is widely adopted still persists. Cookstove adoption depends not only on stove performance but also on social, cultural, and economic factors that can vary greatly by geographical location.

Burn Design Lab's (BDL) goal is to design, build, and disseminate clean cookstoves using a rigorous scientific and engineering process that also intrinsically involves the end user throughout cookstove development. BDL furthermore prioritises local production and distribution of the cookstoves at scale to ensure that cookstove production is sustainable and results in broad benefits for the health, environment and economy of a local population.

Hidden challenges

Nearly three billion people in developing countries (based in Africa, Southeast Asia, Central and South America) still cook on open fires or cookstoves using biomass fuel such as wood, charcoal, dung, and agri-wastes. Gathering fuel can be a dangerous and time-consuming task, with women and children often journeying distances from their homes to collect sticks and branches, exposing themselves to violent crime and other dangers in the natural environment.

Apart from the huge burden of collecting fuel,



Collecting fuel is time consuming and labourious and is often done by women and children, BDL says

basic cooking methods (i.e., with the “three stone fire” concept) are also unsafe because they lead to excessive smoke and other household air pollution, which is responsible for 4.3 million premature deaths annually – more than AIDS, malaria, and tuberculosis combined (estimates by World Health Organization). Basic cookstoves are also environmentally damaging, because harvesting wood

leads to deforestation, and air pollution from fires contributes to carbon emissions that are responsible for global warming.

Manufacturing more effective cookstoves has been attempted for many years, but with limited short- and long-term success. Issues such as low levels of acceptance and poor adaptation by the local population (due to ineffective training and/or cultural factors), lack



Air pollution from open fires can lead to premature deaths

of durability, performance shortcomings, and inability to adapt to fuel changes have emerged as major factors preventing existing stoves from making the dramatic impact that was envisioned at their well-intentioned launch.

Another major challenge in producing clean cookstoves is cost. Often, stove manufacturers work with limited budgets and must continuously find ways to control production and distribution costs.

Cookstoves for domestic use in developing countries are sometimes distributed for free or at subsidised pricing by international non-governmental organisations (NGO) and local governments. When sold on the open market, revenues from sales (\$10 (€9) to \$60 per stove) typically can barely match production costs.

Consequently, at the end of the day, there is no profit to reinvest into researching and developing the technology for improved, next-generation cookstove models. Innovative cookstove designs that can positively impact health and the environment – and also address cultural factors – requires engineering expertise in combustion, heat transfer, fluid dynamics, and material science. In addition, it is essential to involve the end user in every stage of the design process. In practice, the application of rigorous scientific methods to address these problems has proven too costly to afford.

Holistic approach

BDL is working to change these issues by partnering



Prototype and experimental stove units at BDL's facility

with local manufacturers and implementers to blend the latest science and engineering with local organisations connected to the countries and communities being served. BDL focuses on making a measurable positive impact with each cookstove design project that is undertaken. Impact is defined as a combination of a stove's performance, durability, level of adoption, and ability to scale. A holistic and iterative approach is followed during research, design, and development projects attempting to maximise a stove's impact.

Four key steps can help to maximise the stove's impact:

- 1. Performance:** To make the cookstoves safe, efficient, and clean-burning, lab-based research, design and development is augmented by field-based pilot and emissions studies to determine the stoves actual performance in the country or region where it will be used with local fuels.
- 2. Adoption:** To make people want to buy a stove and keep using it repeatedly, BDL holds in-country-based focus groups, home placements, and pilot studies to get reliable design input from future customers of the stove.
- 3. Durability:** To ensure that the stoves will last, BDL's

expertise in cookstove material science is coupled with extensive and ongoing durability testing both in the laboratory and in the field.

- 4. Scale:** To ensure that the stoves get into as many users' homes as possible, BDL partners with local manufacturers and distributors from the earliest stages of the project to full scale.

Current projects and success stories

BDL's current and planned projects include second-generation stick-fed and gravity-fed rocket stoves, a bamboo-fuelled stove and a high efficiency plancha stove. Stoves are designed specifically for the needs of a local population, be it in Kenya, the Philippines, or Guatemala. Many cookstoves designed by BDL are already commercially produced, while others are in the design and development phase. Some of our projects are described below.

Jikokoa charcoal cookstove

The Jikokoa is a charcoal stove designed for East Africa that reduces fuel consumption by more than 50% and reduces harmful emissions by more than 60% compared to traditional cooking methods. BDL's sister organisation, Burn Manufacturing Co. (BMC, a

social venture company) is manufacturing between 6,000 and 10,000 Jikokoa's monthly at their factory near Nairobi, Kenya. More than 150,000 units have been produced and sold to date. The Jikokoa saves families up to \$260 (€232) per year in fuel costs.

Kuniokoa stick-fed rocket stove

Together with a team from the Mechanical Engineering Department at the University of Washington, BDL developed the Kuniokoa natural-draft "rocket" wood-burning stove for use in East Africa. Funded by a grant from the US Department of Energy and backed by an investment



The Jikokoa charcoal stove was developed at BDL with more than 150,000 units sold in East Africa

from Unilever and Acumen, this stove is cleaner and more efficient than any other rocket stove being sold today. Production of the Kuniokoa started this autumn in BMC's Kenyan factory. The stove will be sold to farmers and plantation workers on Unilever's tea estates in Kenya and Tanzania at a cost of approximately \$38 dollars. Initial user satisfaction with the stove, gauged by focus group discussions and home placement of a beta (preview) product, is very high.

Concrete Eko-Stove

BDL developed the Eko-Estufa cookstove for Mexican building materials specialist Cemex in 2012. In November 2014, Cemex committed to installing 100,000 concrete cookstoves to improve the quality of life of approximately half a million people in Mexico and Guatemala by 2017. This cookstove reduces wood consumption for families in Central America by up to 25kg per day.

Gravity stick-fed rocket stove

Developed in cooperation with Bataan Peninsula State University in the Philippines (BPSU), this cookstove is



Field testing of stick-fed rocket stove



Eko-Estufa concrete cookstove developed for Cemex



Guatemalan woman cooking tortillas on a plancha cooktop stove

self-feeding with minimal tending required. BPSU has asked for further help from BDL to increase efficiency, reduce emissions, and reduce manufacturing cost.

Institutional stove

BDL is partnering with InStove, an institutional stove manufacturer from

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Cottage Grove, Oregon, US, to decrease the cost of manufacturing the institutional stove in the developing world while at the same time maintaining its long life, high efficiency,

and strong user appeal. BDL is also making plans with InStove to develop wood-burning stoves for agricultural and microenterprise applications that are currently widely practiced on open, three-stone fires in West Africa.

Washington, US, and was founded in 2010 by cookstove visionary and passionate entrepreneur Peter Scott. What started as a passion to fight deforestation in Africa has grown into an organisation that has successfully designed and implemented improved cookstoves across the globe. By engineering the most efficient way to cook with local fuels, BDL and its partners are combating the effects of deforestation and improving the lives and health of local indigenous people. As a non-profit organisation, BDL relies on grants, corporate sponsorships, and private donations, along with R&D work contracted by cookstove implementers and manufacturers. ●

Improved plancha stove

BDL is currently partnering with the Hands for Peacemaking Foundation in Guatemala to design and build a next-generation plancha (cooktop) stove. Hands for Peacemaking Foundation is an NGO working with the people of northern Guatemala manufacturing cookstoves, latrines, school desks, and water systems.

About BDL

BDL operates its office and test facility in Vashon,

For more information:

This article was written by Paul Means and Arie Verloop of Burn Design Lab. Visit www.burndesignlab.org

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Gravity stick-fed rocket stove