Green Technology Diffusion: **The Case of Arivi Paraffin Cookstoves**

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The Challenge

Approximately 3 billion people worldwide use polluting solid fuel sources to prepare meals and heat their homes. As a result, an estimated 4.3 million people die annually due to indoor air pollution from solid fuels.[1] Moreover, fuel is costly. In many developing countries, households spend between 30 and 90 per cent of their income on biomass for cooking and heating.[2]

The smoke from cookstoves can contain a wide variety of toxic inhalants, depending on the type of fuel used. The primary toxins produced by the indoor burning of fuels – including wood, coal, animal waste, biogas, kerosene, ethanol, agricultural waste, and liquid petroleum gas (LPG) – include fine particulate matter, carbon monoxide, nitrogen oxides, hydrocarbons, formaldehyde, and benzene.[3] Those that fall ill from cookstove smoke primarily contract non-communicable diseases, such as respiratory diseases, cancers, and cardiovascular diseases. Other health problems associated with indoor air pollution include asthma, tuberculosis, low birth weight and infant mortality, and blindness.[4] Over 85 per cent of deaths from non-communicable diseases are associated with the burning of biomass, with the remainder associated with coal.[5]

Biomass, such as firewood, accounts for 35 per cent of energy supplies in developing countries. When biomass is burned, greenhouse gases like methane and carbon dioxide, along with black carbon, are released into the atmosphere, contributing to climate change. Residential biomass use contributes over a quarter of all black carbon emissions worldwide. Trees and other vegetation serve as "carbon sinks", storing carbon dioxide that has been released into the atmosphere. However, vegetation is often cleared but never replaced, eliminating such sinks and magnifying the negative environmental impact of greenhouse emissions.[6]

In sub-Saharan Africa, most firewood collection is considered sustainable, because it comes from trees that are already dead. In fact most rural firewood collection is not believed to contribute to deforestation. Charcoal production, however, requires the trunks or large limbs of trees, which must be cut down. Urban firewood collection, due to the volume required to support the needs of a dense population, can also contribute to deforestation.[7]

Women and girls disproportionately suffer from the lack of efficient, affordable fuel. This is partly because they spend more of their time indoors.[8] Also, they tend to be responsible for securing firewood and other biomass to fuel the stoves, leaving them vulnerable to attack and taking away time that could be spent on education or income-generating activities. Women may also suffer physical injuries as a result of carrying heavy loads of biomass – as much as 38 kg – even when pregnant.[9]

Cooking is one critical human activity that requires a regular supply of fuel. Thus, were users to shift to cleaner fuel sources and safer, more efficient cookstoves, this could positively impact health, livelihoods, and the environment. Clean cookstoves can reduce or eliminate, depending on the fuel used, the harmful respiratory and other health effects of indoor air pollution caused by traditional fuels. This could improve the quality of life for women and children, and for their entire families and communities. Moreover, by eliminating the need to forage for fuelwood or biomass, trees and other vegetation are spared, preventing the release of greenhouse gases.

At a Glance:

ARIVI cookstoves to improve health and safety

- Environmental challenge: Develop superior cookstoves to improve health, safety, family finances, and environment
- Technology solution: Spill-proof paraffin wax-burning clean cookstove
- Technology dissemination: Design and manufacturing in South Africa, with distribution worldwide
- Transactions: Arivi, local agents worldwide
- WIPO GREEN: Platform for identifying customers and agents, and partners

1. WHO Fact Sheet no. 292, March 2014, at www.who.int/mediacentre/factsheets/fs292/en/
2. International Energy Agency (IEA), World Energy Outlook 2006, Chapter 15: Energy for Cooking in Developing Countries, at www.iea.org/publications/freepublications/publication/cooking.pdf
3. Maggie L. Clark, Air Pollution from Cookstove Smoke and Adverse Health Effects Among Honduran Women, 2007, p. 15
4. Global Alliance for Clean Cookstoves, Fact Sheet: Cookstoves and Non-Communicable Diseases, 2010, at www.cleancookstoves.org/resources/fact-sheets/cookstoves-and-disease-1.pdf
5. See International Energy Agency (IEA), World Energy Outlook 2006, Chapter 15
6. NASA Earth Observatory, "Biomass Burning," 2001, at http://earthobservatory.nasa.gov/Features/BiomassBurning/

Technology Solution Developed by Arivi

Arivi, a start-up company based in South Africa, developed an innovative clean cookstove in 2007 that is more efficient, cleaner, and safer for indoor use than other cookstoves in that market. Since 2007, the company has been perfecting its solution, which is targeted at low-income customers in developing countries. The company will begin marketing the stove in South Africa in 2014.

Because shacks in low-income communities are often very close to each other, when a fire breaks out in one home due to a spill from a cheap paraffin stove, the fire can spread quickly to numerous neighboring shacks. Tasos Callantzis, Ferderick Kruger, and Rudi Snyman formed Arivi to develop a product to minimize this danger. They invented a small, efficient individual-use indoor stove with an innovative safety feature, calling it the "Arivi Eva" stove. The Arivi Eva stove burns paraffin wax, a fuel that is widely used in developing countries because it can be purchased in small quantities.

The Arivi Eva stove is an improvement over existing cookstoves due to its automatic shut-off feature. The stove instantly powers down when tilted, moved, or lifted, or when the fuel cap is opened. In addition to preventing fires, this function prevents serious burns due to paraffin wax spills or leaks. The reduction in fire risk is an important selling point of the stove, since many low-income households lack insurance coverage.

Moreover, the Arivi Eva stove is more efficient than other cookstoves due to its innovative design. It has a double insulated wall, which results in less paraffin burned. It has been demonstrated to burn 60 per cent more efficiently than competing products on the market, enabling the user to save money on fuel while also creating fewer emissions. This also reduces indoor air pollution, especially when used in place of wood or other biofuels. And the Arivi Eva stove has been shown to last longer than most stoves, having been granted regulatory approval for 500 hours of continuous use.

In addition to safety and performance, the Arivi Eva stove responds to other customer needs. For instance, customers complained that paraffin wax emits a pungent smell when burned, which can impregnate clothing. To address this concern, the burner inside of the Eva stove has been designed to consume not only paraffin wax, but also the paraffin fumes.. The Arivi founders also recognized the desire among their target customers, despite their low incomes, to own luxury products like flat-screen televisions. With this in mind, the Arivi Eva stove has been designed to have the aesthetic appeal of a high-end product.

The stove requires minimal maintenance, and the product comes with a one-year warranty. For service needs, customers can send an SMS from their mobile phone to an Arivi hotline. Arivi will then arrange for a technician to be sent out, or for the stove to be returned to the factory for repair or replacement.

Technology Diffusion and Outlook

The Arivi Eva stove will be available commercially in South Africa, then elsewhere, in 2014. It will be affordably priced at the equivalent of USD 33. In South Africa, the solution will be marketed through radio spots and print ads, since many customers in the target demographic lack televisions, and through word-of-mouth.

For distribution, the company plans to establish a network of direct sellers embedded in their communities. This approach will enable Arivi to work through sellers who understand the true needs of the customers, to obtain feedback from customers and therefore improve the offering, and to create jobs in South African communities that are target markets for the product. During early product testing, customer feedback was critical in enabling the company to identify and fix product shortcomings, such as a loose fuel cap that could get lost (which was redesigned for a better, more secure fit). Arivi anticipates using the same distribution approach worldwide, launching initially in Southern Africa then in other regions.

The Arivi Eva cookstove is currently manufactured only in South Africa, though Arivi plans to license manufacturing to a company in China. The product is patent-protected in South Africa, and the company is actively expanding its portfolio to ensure that its key innovative features are also protected in other key markets. The company has also registered the Arivi trademark in key markets.

The Arivi Eva has been uploaded to WIPO GREEN, and Arivi expects this platform will contribute to marketing efforts, including identification of appropriation local partners worldwide.

7. World Bank, Deforestation Trends in the Congo Basin: Reconciling Economic Growth and Forest Protection, Working Paper 2: Wood-based Biomass Energy, April 2013, at www.profor.info/sites/profor.info/files/docs/Biomass%20Energy_Sectoral%20Report_FINAL%5Bweb%5D_may13.pdf
8. Global Alliance for Clean Cookstoves, Fact Sheet, 2010 at www.niehs.nih.gov/research/programs/geh/cookstoves/global_alliance_for_clean_cookstoves_fact_sheet_508.pdf
9. Global Alliance for Clean Cookstoves, Fact Sheet: Cookstoves and Women, 2010, at www.cleancookstoves.org/resources/fact-sheets/cookstoves-and-women-1.pdf

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