

ENDELEVU:

ADDRESSING HOUSEHOLD AIR POLLUTION THROUGH CLEAN COOKING PROMOTION

ABSTRACT

About 9 million households in Kenya use unclean sources of energy such as firewood, charcoal and kerosene. These energy sources are responsible for HAP which claims the lives of 21,600 Kenyans annually. Various brands of clean cookstoves and fuels are currently available in Kenya. Despite this, the use of the cookstoves and fuels by households that desperately need them is still low. The two key barriers to widespread use of these clean cooking options are limited access (availability and affordability) and adoption (awareness and acceptability). Owing to these barriers, the most vulnerable households cannot transition to the use of clean cooking fuels and are therefore exposed to HAP-related ailments and possible death.

Our proposed project, 'Endelevu', is a social venture that seeks to increase the access to and adoption of clean cookstoves by Kenyan households by raising awareness on clean cooking and providing dedicated online and physical clean cookstove shops. It will achieve this by establishing a clean cooking e-commerce platform and clean cookstove kiosks in healthcare facilities. These will be supported by a national clean cooking behavior change campaign spearheaded by Community Health Extension Workers (CHEWs) and Community Health Volunteers (CHVs) to activate the demand for the clean cookstoves. Endelevu will pilot a 'health approach' to addressing the challenge of household air pollution.

Project team:

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OVERVIEW OF CURRENT HOUSEHOLD ENERGY USE FOR COOKING

In 2016, three billion people (41% of the world’s population) were still cooking with polluting fuel and stove combinations. A third of the world’s population rely on the traditional use of solid biomass to cook their meals. Around 120 million people use kerosene and 170 million use coal. (1) If current trends continue, 2.3 billion people will continue to use traditional cooking methods in 2030 (2).

Biomass dominates in sub-Saharan Africa’s energy mix, where it accounts for about 60% of total energy demand, three-quarters of which is used in households. (1) In Kenya, biomass fuels account for about 69% of the total primary energy consumption. (3)

About 780 million people in sub-Saharan Africa, almost four-fifths of the population, rely on solid biomass for cooking. Biomass accounts for over 90% of the total population without clean cooking access. This number has grown by nearly 50% since 2000, as population growth has outpaced the number of people gaining access to clean cooking. Furthermore, 6% of the population (about 60 million people) cooks with kerosene, and is used by 12% of urban households. While 68% of Africa’s urban population lack access to cleaner fuels for cooking, about 92% of the continent’s rural population cook with fuelwood, charcoal, dung and agricultural residues. (1) In Kenya, 73% of the population live in rural areas, and 95.5% of them cook mainly with solid fuels or kerosene; while of the 27% who live in urban areas, 45.6% cook mainly with solid fuels or kerosene (4)

IMPACTS OF CURRENT UNSUSTAINABLE HOUSEHOLD ENERGY USE:

Climate Change: Greenhouse-gas emissions from the energy sector represent roughly two-thirds of all anthropogenic greenhouse-gas emissions. (5) Kenya’s energy sector (excluding transport and industry) accounted for 7.1% of total emissions in 2015 and is projected to rise to 29.7% in 2030. The transport sector directly accounted for about 13% of Kenya’s total GHG emissions in 2015 and is projected to rise to 17% of total national emissions in 2030. (6)

Deforestation: Cooking with biomass results in the consumption of over 300 million tonnes of fuelwood per year, which can exacerbate deforestation in stressed areas. (7) Biomass represents 10% of total primary energy demand. Half of it is used for cooking, mostly in the forms of fuelwood, agricultural residues and charcoal. Net deforestation for firewood accounts for about 3% of anthropogenic CO₂ emissions. While wood is considered renewable, it is exhaustible unless stocks are managed sustainably. (1)

Air pollution causing a major environmental health risk: Air pollution is the fourth greatest overall risk factor for human health worldwide, after high blood pressure, dietary risks and smoking. In 2016, household and outdoor air pollution led to some 7 million deaths worldwide. (2) This is much greater than the number from HIV/AIDS, tuberculosis and road injuries combined. (8) Among the major air pollutants, fine particulate matter is the most damaging to human health, and sulfur oxides, nitrogen oxides and ozone are associated with a range of illnesses. Consumption of biomass, kerosene and coal in the buildings sector, along with industrial use, are responsible for the bulk of the particulate matter reaching the atmosphere. (9)

7.5 million tonnes (Mt) of PM_{2.5} are emitted annually in Africa today, of which almost three-quarters is from the burning of biomass indoors. This is attributed to over half a million premature deaths, higher than the number of deaths from malaria. The use of kerosene for cooking and lighting is also a grave source of fires and casualties in households (10).

In 2016, HAP from solid fuel use resulted in an estimated 3.8 million premature deaths. This toll is equivalent to 6.7% of global mortality, greater than that from malaria, tuberculosis (TB) and HIV/AIDS combined. Of these deaths, 403 000 were among children under 5 years of age (10). HAP is also an important source of AAP, as residential cooking contributes as much as 12% of global PM_{2.5} to ambient air (11). Acute respiratory infections, often caused by household air pollution (HAP), are the second leading cause of death in Kenya and account for 26% of all deaths in Kenyan hospitals. More than 60% of all premature deaths from household air pollution are among women and children. (4)

In many parts of the world, children are especially vulnerable to HAP because they spend a great deal of time in the home and with their mothers as the latter tend the hearth (12).

Traditional stoves and three-stone fires are damaging to people's lives in other ways. People need to spend many hours each week gathering fuel – time that could be spent by adults (particularly women) in employment, and by children, when they should be at school. Alternatively, they spend money they can ill afford to buy fuel.

ADDRESSING THE IMPACTS OF HOUSEHOLD ENERGY USE

The scientific evidence outlined above presents a strong case for concrete actions to reduce the exposure of pregnant women, children and adolescents to air pollution. (13)

Addressing these negative impacts of cooking includes solutions that reduce the demand for biomass, and those that avoid harmful emissions by promoting clean forms of fuels and efficiently-burning cookstoves. Addressing issues of affordability, lack of consumer awareness about the benefits of clean cooking, and minimal financing for producers of clean cooking energy technologies are key to accelerating the rate of access to clean cooking. (5)

According to (14), a paradigm shift is required in 'making the clean available, as well as making the available clean'. This can be achieved by the following strategies: improved stove design, fuel upgrading, and improved ventilation.

Improved stove designs

A clean cookstove should be both fuel and emission efficient, so as to ensure conservation of the fuel as well as the environment. The strategies adopted to achieve this are: to increase the heat transfer as well as the combustion efficiency. The emission of the pollutants is inversely proportional to the combustion efficiency and the overall efficiency is inversely proportional to the amount of fuel used. (15)

Upgrading cooking fuels or switching to other clean fuels

The variety, unpredictability and inconsistency of natural solid biomass are the primary challenges for clean combustion in a traditional cookstove. However, this by no means makes biomass a dirty fuel; if solid biomass is converted into a predictable fuel such as woodchips,

briquettes or pellets and burned in an efficient cookstove, emissions have been proven to come closest to the aspirational targets of IWA tier 4. (16)

Cooking fuels, in gas form such as natural gas and LPG, in liquid form such as ethanol, and in specialized form such as electricity, are more appropriate and usually preferred for cooking for clean cooking. However, in practice, a mass movement to these fuels is hindered by high levels of household poverty and the poor development of market for these fuels. Thus, fuelwood/biomass fuel is still widely used for domestic cooking in all developing countries.

Improving the Kitchen environment

The placement of the kitchen vis-a-vis the rest of the building can have a profound effect on the quality of the indoor climate due to the transmission of heat and food odours, produced during cooking, to the rest of the dwelling. Where feasible, kitchens should not be placed adjacent to utilities such as toilets and animal sheds.

The improved ventilation strategy involves the provision of a chimney or a hood to vent the smoke produced or to increase the air exchange rate. Building materials such as mini-skirt walls (combining blocks and bamboos that act as air filters) can also be used for diffuse ventilation of the kitchen.

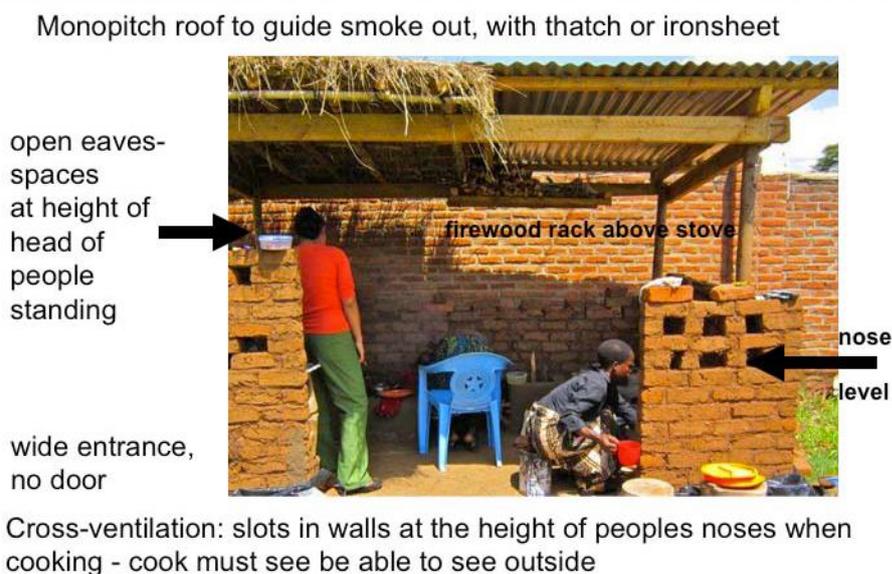


Fig. 1: Ventilation features of a simple kitchen. Source: reference (17)

CURRENT INTERVENTIONS

Information on efficient and clean cooking technologies and their application already exist. A growing number of governmental, non-governmental and private-sector organizations have participated in initiatives to improve indoor air quality and reduce biomass fuel consumption. Interventions include improved ventilation, cleaner and more efficient fuel sources, and improved stoves that increase fuel economy and reduce emissions. These interventions are either promoted as philanthropic or for profit ventures. The current entrepreneurial approaches to the distribution of clean cooking solutions are summarized in the table below.

Model	Village Level Entrepreneur (VLE)	Piggybacking	Proprietary Sales Network
Description	Engaging local entrepreneurs and artisans through various incentive structures to distribute selected additional products within their communities.	Partnering with supermarkets, hardware stores, community-based organizations, micro-finance institutions or other networks already operating in last-mile markets with access to BoP consumers.	Setting up a new proprietary distribution channel, including direct delivery, to serve the target market.
Advantages	<ul style="list-style-type: none"> – Low investment costs, including for distribution in rural areas – VLEs direct knowledge of customers – VLE are known in communities – Overall scalability 	<ul style="list-style-type: none"> – Low investment costs; no need for additional infrastructure – Reduced time to establish markets – Network builds on prior consumer trust – Scope for consumer finance 	<ul style="list-style-type: none"> – Useful to push new products – Enhanced opportunities for branding – Full control and oversight – Convenient for setting up consumer finance and after-sales services
Strategies	<ul style="list-style-type: none"> – Difficult when product is new/unknown – High financial risk for VLE – Limited control and oversight – Limited scope for branding or product diversification – Difficult to set up after-sales service and consumer finance schemes 	<ul style="list-style-type: none"> – Network actors need to be actively engaged – Potentially limited market that can rapidly become saturated (depending on the market size of the partner) – Limited control and oversight 	<ul style="list-style-type: none"> – Costly timewise and moneywise – High financial risk involved – Hard to reach customers in remote areas given costs involved

Reference (18)

BARRIERS TO UNIVERSAL CLEAN COOKING ACCESS

Despite several decades of actions to improve access to clean cooking solutions, the challenge of Household Air Pollution still persists. The situation is particularly dire in Africa where the population using non-solid fuels is rising significantly as shown in the graph below. Yet Africa is not actively leading the debate on reversing this trend.

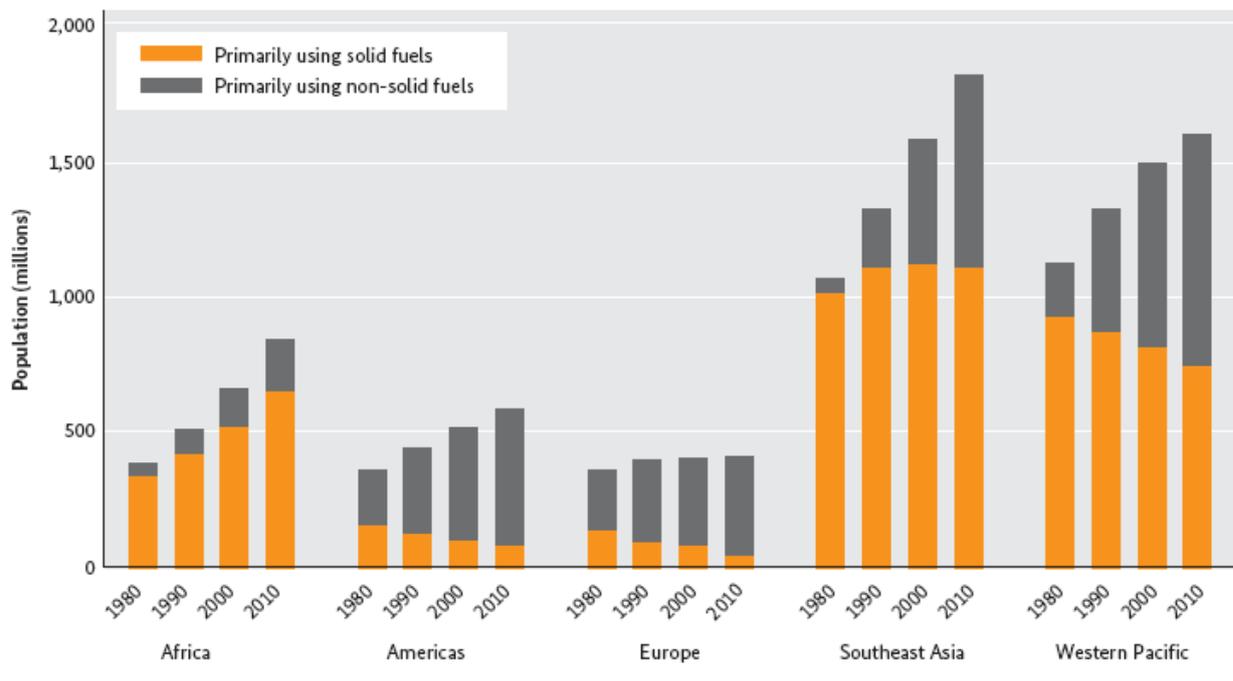


Figure: Reference (19).

The underlying barriers limiting universal access to clean cooking can be represented by the four A-model: access, availability, awareness and acceptability.

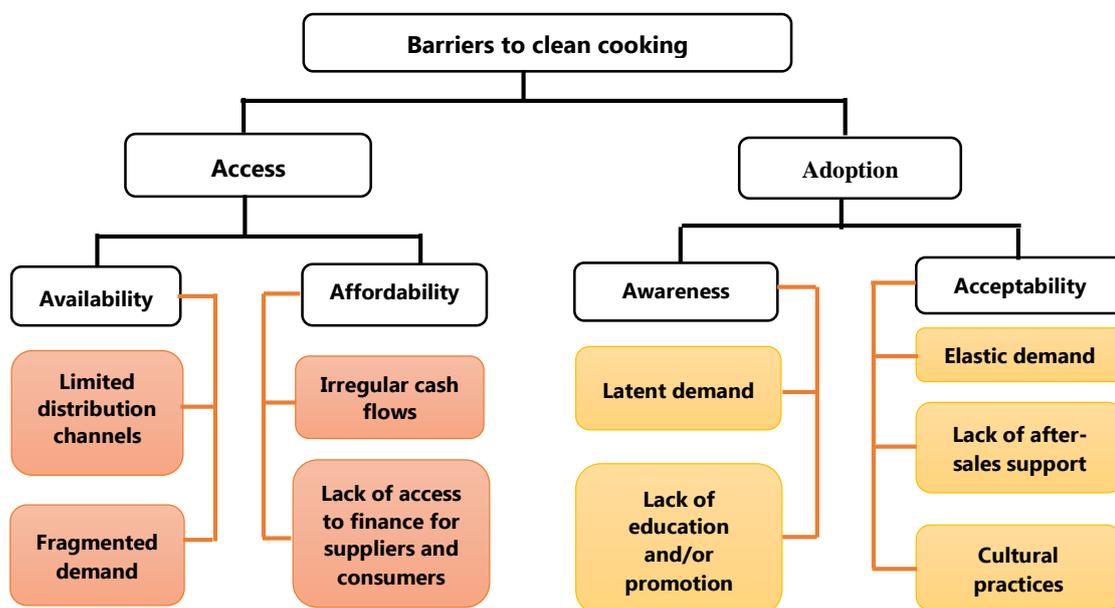


Fig. 3: Barriers to universal transition to clean cooking. Source: reference (18)

Poverty, disparities in distribution of wealth and demographic challenges complicate the development of Africa’s biomass energy technologies. Because of high poverty levels many households cannot afford modern biomass energy technologies. Africa’s rapid population growth makes it challenging to meet the increasing energy demand from biomass due to competition for other land uses. The continent population is characterized by disparities in wealth distribution due to the disproportionate poverty in rural and informal urban settlements.

For example, Kenya's estimated wealth disparity in 2016 was 47.7% with 90% of Kenyans in the bottom 40% of the income distribution live in rural areas. (20)

Poor condition of infrastructure such as roads is a real barrier, especially in remote places, limiting "last-mile" distribution of clean biomass energy technologies. 90% of the total Kenyan rural road network in 2013 was unpaved with 67% of this network in bad condition. (21)

Socio-economic and cultural barriers. Level of awareness on the health impacts of traditional biomass energy use and the potential of the available renewable energy technologies remains low. This is further complicated by culturally inappropriate energy technologies such as ethanol stoves that do not take into consideration cultural practices that demand for use of multiple sized pots.

Africa still faces widespread poverty, with more than 40% of its population living below the poverty line. About 33.5% of its working population (excluding North Africa) lived in extreme poverty (under \$1.90 a day) in 2015. (22) The burden of poverty is much higher among women and youth. The proportion of the population covered by social protection systems is small, with low levels of social protection coverage holding back poverty reduction efforts in Africa. These factors makes affordability and accessibility of the modern biomass energy technologies a huge challenge, unless innovative financing models are designed.

Data challenge:

Data on the performance of improved stoves and clean fuels in real household conditions are less robust, though current evidence suggests that stove field performance approaches laboratory results. (19) There is also a large data and knowledge deficit on the issue of cookstove adoption. Besides, consumers are usually nervous about new technology in areas without prior adoption of clean cooking technologies due to inadequacy of knowledge about the product.

Lack of after-sales support (Lack of spare parts and repairing services):

Unlike major consumer durable goods purchased by upper-middle/upper quintile consumers, most improved stoves available today do not provide much after-sales support, if any. Both price points and the relative scale of the industry impose limitations on the ability of manufacturers to provide economically efficient after-sales service. (19) This lack of after-sales support has three key implications for adoption and use of improved stoves:

- Customers may be deterred from original purchase if there is uncertainty around how/when/if they will have access to repairs or support.
- Without adequate after-sales training for consumers on proper use of the stoves, customers may believe that stoves do not work properly, hurting brands, and the market as a whole.
- Lack of after-sales support makes tracking and monitoring of cookstove distribution and use very difficult.

Unless the above gaps and challenges are addressed, 650 million people – more than one-third of Africa's population will still cook with biomass in an inefficient and hazardous way in 2040 as projected by IEA analysis. (1) This calls for a paradigm shift in how clean household cooking energy access programs are designed.

TOWARDS A NEW APPROACH FOR ADDRESSING HAP

WHO has already presented a strong case for the need of active engagement of health professionals in addressing HAP (13).

Health professionals are trusted sources of information and guidance. They play an important role not only in treating ill health caused by air pollution but also in educating families and patients about risks and solutions and communicating with the broader public and decision-makers. The role of health professionals in the management of childhood exposure to air pollution must be amplified, through improved methods of care and prevention and collective action. Health professionals can provide evidence to shape public health policy and advocate for effective policies to reduce children's exposure to air pollution. The broader health sector must become more engaged in developing a comprehensive approach to addressing this crisis. (13)

Despite such a call, there is still no known health-driven approach to promote a market-driven access to clean cooking solutions in Africa. It is against this backdrop that we present a project proposal to pilot a health-approach to the distribution of clean cooking solutions in Kenya.

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OUR PROPOSED PROJECT:

PILOTING A HEALTH APPROACH TO THE DISTRIBUTION OF CLEAN COOKING TECHNOLOGIES FOR HEALTH AND CLIMATE OUTCOMES

Overview of our proposed project – ‘Endelevu’

‘Endelevu’ is the Swahili word for sustainability. It is a social venture that seeks to increase the access to and adoption of clean cookstoves by Kenyan households by raising awareness on clean cooking and providing dedicated online and physical clean cookstove shops. It will achieve this by establishing a clean cooking [e-commerce platform](#) and clean cookstove kiosks in healthcare facilities. These will be supported by a national clean cooking behavior change campaign spearheaded by Community Health Extension Workers (CHEWs) and Community Health Volunteers (CHVs) to activate the demand for the clean cookstoves. Endelevu will pilot a ‘health approach’ to addressing the challenge of household air pollution.

The main barriers being addressed by Endelevu

The two key barriers to widespread adoption of clean cookstoves in Kenya are limitations in access (availability and affordability) and adoption (awareness and acceptability).

- Currently, clean cookstoves merchants in Kenya rely solely on physical distribution of their products. This limits their visibility, reach, and ultimately the number of households embracing their technologies.
- So far clean cookstoves projects have focused on environmental benefits (savings on fuels from efficiency). Yet a number of clean cooking market assessment studies and national economic surveys show that Kenyans prioritize social issues such as education and health in their household investment decisions.
- The role of influencers and word of mouth in raising awareness and breaking cultural barriers to adoption of critical products has also been established. Yet clean cooking awareness campaigns often don’t target the most strategic ‘community-level social influencers’ such as health workers, religious leaders and teachers.

Endelevu's approach to addressing the barriers to clean cookstove distribution

- First, we will organize an awareness campaign in partnership with health institutions to catalyze the demand for clean cookstoves. We will leverage on the wide network of the Ministry of Health’s Community Health Extension Workers and Community Health Volunteers spread across the country.
- Second, we will provide an online clean cooking marketplace in the form of an e-commerce platform (www.endelevu.ke). The platform will give cookstoves and fuel merchants a one-stop shop for displaying and increasing visibility of their products. On the other hand, it will allow online shoppers to access these products with ease. This way, the platform will help ENDELEVU leverage increased internet penetration and adoption of smartphones, growth of e-commerce in Kenya, and increased demand for convenience amongst shoppers.
- Lastly, the platform will be supported by strategically located physical distribution points, or ‘*Endelevu Kiosks*’ strategically located in healthcare facilities. Endelevu Kiosks will

serve as points of delivery and independent shops for online and offline shoppers respectively. They will also be used for after-sale support and awareness creation. To increase affordability, Endelevu will offer flexible instalment payment options by leveraging on informal saving groups and the Government’s Social Welfare Programs.

Elements to be tested proved during Endelevu's Pilot Phase

ENDELEVU aims at using digital technologies and applying a “health and empowerment approach” to distribute clean cooking technologies. We will adapt some of the methodologies used in the successful distribution of water and sanitation and fight against malaria in the promotion of clean cooking solutions.. We will work with Community Health Workers (CHWs) to raise awareness to patients especially pregnant and lactating mothers on the need for adopting clean cookstoves to mitigate respiratory diseases. We will also work with the large network of Community Health Volunteers (CHVs) as our ‘grassroot marketers’ and last-mile distributors. Before we scale up, it is critical to test the most appropriate strategies for engaging these professionals. We will also need to finalize developing the e-commerce platform, on-board merchants, test the platform’s technical functionality and develop a sustainable pricing structure for the products.

Expected impact of Endelevu:

- Endelevu will contribute to addressing household air pollution (HAP) and the associated ailments which are responsible for 21,600 deaths in Kenya annually.
- We conservatively calculate that: each woodfuel Improved Cookstove (ICS) adopted under Endelevu, during its lifetime (2-3 years), saves 260 to 480 kg of wood biomass per year compared to traditional cooking on fire; each charcoal ICS saves 1,310 to 1,500 kg of wood biomass per year compared to a basic charcoal stove.

Projected outcome within the first 2 years of intervention.

Outcome	Timeline		
	3 months (Nairobi)	1 year	2 years
No. of Stoves distributed	600	13,000	26,000
Total # households	600	13,000	26,000
Total # beneficiaries	3,000	65,000	130,000
Total # female beneficiaries	1,205	26,114	53,032
Total # women-headed households	192	4,160	8,320
Total # children	1,560	33,800	67,600

Estimated budget for the pilot program:

	Item	Cost (USD)
1.	Licenses and Trademark registration	500
2.	Market research and activation (Awareness campaign, On-boarding merchants, healthcare facilities, CHWs, CHVS)	5,000

3.	E-commerce website design	2,000
4.	Purchase of initial stock of stoves of stoves and fuels (200 stoves)	8,000
5.	Office operations (office rent, communication and wages)	5,000
6.	Design and construction of model Endelevu kiosk	5,000
	Total	25,500

Our long-term vision for the proposed venture (Endelevu):

Distribute at least 500,000 cookstoves throughout Kenya in 5 years by partnering with the National and County Governments to mainstream clean cooking into the Maternal and Child Health (MCH), Safety Net program (the program is currently providing cash transfers to 800,000 vulnerable households), Women and Youth empowerment programs.

Anticipated revenue streams:

Endelevu will generate revenue from four key streams. These include;

- i. Margins from the sale of the cookstoves and fuels
- ii. Delivery fees
- iii. Sale of advertising space on the e-commerce platform

The progress we have made so far in establishing Endelevu

Since the conception of the idea, we have, so far, achieved a considerable milestone which includes initial application for the registration of ‘Endelevu’ trademark, registration of the web platform domain (www.endelevu.ke) and we are currently at the initial phase of the e-commerce site development. We have participated in the National Technical Working Group on Energy, Health and Climate Change where we have worked with other stakeholders to develop a Curriculum and Manual for Training CHEWs and CHVs on Climate Change and Household Air Pollution. This has not only positioned us strategically as an authority in the clean cooking sector greatly but also informed our in-depth market research and the development of an inclusive business model.

We have also begun contacting relevant merchants whose products will be sold through the platform. Finally, we are in the process of formalizing partnerships with strategic organizations, chief among them, the Ministry of Health.

Our next steps or targets to achieve in the next 3-12 months?

We are working towards completing the online e-commerce platform within the next 3 months. This task will be completed along with the registration of at least 5 leading merchants who will be used both to pilot and supply the products. The pilot will be conducted to ensure the system meets all required technical specifications after which the platform will be officially launched. We also intend to formalize at least two strategic partnerships and endorsements. Strategic marketing and market activation exercises will be our key priority within the first 12 months, utilizing all the possible channels including media and outreach programs across the country. Out of the addressable market of nearly 9 million Kenyan households that depend on unclean cooking energy sources, we intend to reach out to at least 13,000 households by selling the products to them within the next 12 months.